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CAMBRIDGE.

A BRIEF ACCOUNT OF THE OPEN SCHOLARSHIPS, &c., WITH SPECIMENS OF THE EXAMINATION PAPERS.

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A BRIEF ACCOUNT

OF THE

SCHOLARSHIPS AND EXHIBITIONS

OPEN TO COMPETITION

IN THE UNIVERSITY OF CAMBRIDGE,

WITH

SPECIMENS OF THE EXAMINATION PAPERS.

BY

ROBERT POTTS, M.A.,

TRINITY COLLEGE.

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1866.

The following brief account of the Scholarships, Exhibitions, and Sizarships, open for Competition at the different Colleges in Cambridge, is taken partly from the Second Part of the *Liber Cantabrigiensis*, which was published in 1863.

The specimens of the Examination Papers for the Scholarships, &c. open to competition before residence, are given for the information of such students as may be desirous of becoming Candidates for these aids in their Academical Education.

In addition to the Scholarships, Exhibitions and Prizes open to Competition at the different Colleges, amounting in value to about £40000 a-year, there are the "University Scholarships and Prizes" open to the Competition of the whole University in value upwards of £2000 a-year.

Students may obtain full information respecting the open Scholarships, the times fixed for the Examination, &c. at any College, by applying by letter to the Tutor of that College.

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UNIVERSITY OF CAMBRIDGE.

THE COLLEGES.

OPEN SCHOLARSHIPS.

The Cambridge University Act, 19 and 20 Vic. cap. 88, sect. 46, declares that—

"From and after the first day of Michaelmas Term, one thousand eight hundred and fifty-six, it shall not be necessary for any person, on obtaining any Exhibition, Scholarship, or other college emolument, available for the assistance of an undergraduate student in his academical education, to make or subscribe any declaration of his religious opinion or belief, or to take any oath, any law or statute to the contrary notwithstanding."

The College statutes framed under the powers of the Act, contain provisions for carrying out the designs of the legislature, and for "extending the sphere of the utility of the University of Cambridge."

The Scholarship Funds at all the Colleges have been considerably augmented, both by the conversion of Fellowships into Scholarships, and by permanent payments from the general revenues of the Colleges to the Scholarship Funds.

The 45th section of the Act provides that—

"From the first day of Michaelmas Term, one thousand eight hundred and fifty-six, no person shall be required, upon matriculating, or upon taking, or to enable him to take, any degree in arts, law, medicine, or music, in the said University, to take any oath or to make any declaration or subscription whatever; but such degree shall not—until the person obtaining the same shall, in such manner as the University may from time to time prescribe, have subscribed a declaration stating that he is *bona fide* a member of the Church of England—entitle him to be or to become a member of the senate, or constitute a qualification for the holding of any office, either in the University or elsewhere, which has been heretofore always held by a member of the United Church of England

and Ireland, and for which such degree has heretofore constituted one of the qualifications."

Under the powers of the Cambridge University Act, the ancient liberties of the University have been restored, all Academical oaths have been abolished, and a solemn declaration has been substituted in certain cases where oaths were formerly required.

The University of Cambridge has now, under the New Statutes, the power of conferring the Degrees of Bachelor of Arts, and Master of Arts; of Bachelor of Laws, Master of Laws, and Doctor of Laws; of Bachelor of Medicine and Doctor of Medicine; of Master in Surgery; and of Bachelor of Music and Doctor of Music, on all persons who have performed the conditions and exercises prescribed for the respective degrees, independently of every other consideration.

The University has also the power of conferring Honorary Degrees for distinction in Literature and Science, not only on British Subjects, but also on the subjects of all Nations.

The Degrees of Bachelor of Divinity and Doctor of Divinity, can only be conferred on persons who have been admitted to Holy orders in the United Church of England and Ireland.

There is, therefore, now no impediment to any person whatever enjoying the aids for academical education at Cambridge, and proceeding to all the degrees granted by the University, except those in divinity.

ST. PETER'S COLLEGE.

The Scholarships of this College, many of them having been of small value, have been consolidated under the powers of the new statutes, which ordain that all the Scholarships shall be open, and that there shall be twelve of not less than £60 a-year, six of not less than £40, and five of not less than £20.

The vacant Scholarships are filled up from those students who are most distinguished at the Annual College Examination, which takes place in the Easter Term.

They are tenable until the Scholars are of standing to take the degree of B.A.; but the Master and Fellows may, in any case which shall appear to them of special merit, prolong the time of any such Scholarship, until the holder thereof is of standing to take the degree of M.A., or for some shorter period.

Three Scholarships yearly, one of £60, one of £40, and one of £20, have been opened to the competition of students who intend to commence residence in October. The Examination for these Scholarships takes place at the same time as the Annual College Examination.

Exhibitions. Mr. Miller's Exhibition is restricted to Huntingdon Grammar School, but if no qualified candidate offer himself when it becomes vacant, it is declared open to competition. There are also two other Exhibitions, one of £25 from the Clothworkers' Company, and the other of £2. 15*s.* from the Ironmongers' Company, appropriated to students at this College.

Sizarships are not recognised in the new statutes. The four Sizarships, however, which existed under the old statutes, are continued, and one sizar is selected every year, after Examination. The sizars dine in Hall free of expense, and have other advantages. One of the sizars holds the office of Chapel Clerk, the emoluments of which are about £20 a-year. Sizars are eligible to Scholarships as other students, and two Scholarships may be held by a scholar of distinguished merit.

The income available every year for Scholarships, Exhibitions, Sizarships, and Prizes at this College, is between £1100 and £1200.

CLARE COLLEGE.

At this College there are twenty-four open Scholarships; eight of £60, eight of £40, and eight of £20 a-year, tenable for not longer than half a year after taking the B.A. degree. The scholars are elected every year out of the best proficients at the College Examination, which takes place at the beginning of June.

A scholar who, in the first year, may have gained a Scholarship of £40 or £20, may be promoted, if deserving, to a Scholarship of higher value; and in case of singular merit, he may hold two Scholarships.

There are besides two minor Scholarships, one of £60, and one of £20 a-year, open for competition to students under twenty years of age, who have not commenced residence in the University, or who are keeping their first term. These Scholarships are tenable for three years, or until the scholar is elected to a Foundation Scholarship.

Exhibitions. The two Exhibitions, each of £50 a-year, restricted to Wakefield Grammar School, are thrown open to Competition, if no candidate from Wakefield School, of sufficient merit, present himself.

One of about £50 a year, appropriated to a student from the Grammar School of Hull.

Four, each of £32 a year, with a preference to students who have been educated at the Grammar Schools of Oakham or Uppingham.

The income available every year at this College for Scholarships, Exhibitions, and Prizes, is between £1200 and £1300.

PEMBROKE COLLEGE.

At this College, it is ordered by the new statutes, that there shall be twenty open Foundation Scholarships, of which eight are each of £60, six of £40, and six of £20 a-year. In cases of distinguished merit the Scholarships of £20 a-year are tenable with those of £40, and of £60 a-year.

Under the powers of the new statutes, three Scholarships—one of £60, one of £40, and one of £20 a-year—are open to the competition of students who have not commenced residence in the University, and are tenable till the general Annual College Examination.

Besides the Foundation Scholarships, there is a Scholarship of £60 a-year, appropriated to a scholar from the Free School of Bowes, in Yorkshire; but in case of there being no properly qualified candidate from the school, the Scholarship is regarded as an open Scholarship.

There are also three Scholarships, each of the annual value of £28, with a preference to natives of Cumberland and Westmorland, educated at St. Begh's Grammar School.

There is one Exhibition of £70 a-year for a student from the Grammar School of Blackrode in Lancashire: also another of £5 for a student from the same School.

The total amount available every year at this College for Scholarships, Exhibitions, and Prizes, is between £1000 and £1100.

GONVILLE AND CAIUS COLLEGE.

There are thirty-six Scholarships at this College, all perfectly open, of which nine are of £60, nine of £40, six of £30, and twelve of £20 a-year each. The vacancies in the Scholarships are filled up annually from the students of the College, after the College Examination, in the month of June.

One of the Scholarships is given for proficiency in anatomy and physiology, and another for proficiency in chemistry, if deserving students present themselves at the Examination on these subjects.

Two Scholarships, each of £60, are open to the competition of students under twenty years of age, who have not commenced residence in the University, or who are at the commencement of such residence, though their names may not be on the boards of the College. One is given to the most distinguished candidate in classics, and the other to the most distinguished in mathematics.

There are besides these, two other Scholarships each of the annual value of £52. 10*s*. appropriated to students from Harrow School.

The Chapel Clerkship is given as an exhibition in the third year to a deserving student who has failed in gaining a Scholarship.

There are besides two exhibitions, each of £10 a year for four years, to two students from Harrow School.

The Tancred Studentships are four Studentships in medicine, connected with this College, and are each of the value of £113. 8*s*. per annum. Information may be obtained from B. J. L. Frere, Esq., New square, Lincoln's Inn, London, respecting the mode of application.

The income available every year at this College for Scholarships, Exhibitions, and Prizes is between £1900 and £2000.

TRINITY HALL.

There are sixteen Scholarships perfectly open on the foundation of this College, of which three are each of the value of £60 a-year, and the value of the remaining thirteen is settled annually according to the merits of the candidates. These thirteen Scholarships range in value between £50 and £13 a-year.

The Scholarships are awarded to meritorious students of the College, who have distinguished themselves at the Annual College Examinations.

Augmentations may be made to the Scholarships held by students of distinguished merit in their second and third years of residence.

Exhibitions. Two Exhibitions, one of £60 and one of £50, have been opened to the competition of students under twenty years of age, in the Easter Term, before they commence residence. They are tenable during the first year of residence.

The Law Studentships. Three Law Studentships have been established for the assistance of such meritorious students of the College as intend to prepare themselves for practice in the profession of the law.

The Law Studentships are each of the value of £50 a-year, and are tenable for three years; they are vacated on admission to a Fellowship.

The income available every year at this College for Scholarships, Exhibitions, and Prizes, is between £600 and £700.

CORPUS CHRISTI COLLEGE.

There are twenty-five Scholarships unrestricted at this College, of which four are of £60, four of £50, four of £40, six of £30, four of £25, and three of £20 a-year each.

Six of the eighteen Scholarships between £60 and £30 a-year, are awarded to those freshmen who most distinguish themselves at the College Examination, which takes place in the Easter Term, and are tenable for three years. The scholars receive the payment of their Scholarships according to residence. A scholar holding a Scholarship of £60, £50, £40, or £30 a-year, receives 30*s.*, 25*s.*, 20*s.*, or 15*s.* a-week for any number of weeks he may reside, not less than twenty-six, nor more than forty, in the year.

The four Scholarships of £25 a-year, and the two of £20 a-year, are given to junior sophs who are considered most worthy, and the other two to deserving students needing assistance.

One Scholarship of £20 a-year for three years, with rooms rent free, is open at the beginning of October to the competition of students who have not commenced residence in the University. The Examination for this Scholarship is restricted to the Latin and Greek languages. This Scholarship may be held with any other.

The Bibliotistæ or Bible Clerks of the old statutes are recognised in the revised statutes as scholars of the College. Each receives a stipend of £30 a-year, and one of them is organist with an additional payment of £20 a-year.

Exhibitions. One of £36 a-year and another of £30 a-year, for students from St Paul's School, London.

Two of £30 a-year to students from Canterbury and Westminster Schools.

One of £24 a-year to a student from the Grammar School of Norwich, or Aylsham.

One of £18 a-year to a student from the Grammar School of Norwich, Wymondham, or Aylsham.

One of £6. 13*s.* 4*d.* to a student from Canterbury School.

In default of any duly qualified candidates for these Exhibitions, from the respective Schools, they are thrown open to the general competition of the students of the College.

Any of these Exhibitions may be held with a Scholarship or Sizarship. The revised statutes do not recognise sizars as a class of students on the foundation. Six sizars are however, admitted, two every year, after an Examination at the beginning of the Michaelmas Term. They have an allowance for commons and other advantages, and are eligible to Scholarships and Exhibitions, in the same manner as the other students.

The office of sub-librarian is held by an undergraduate, and the stipend is £10 a year.

Several small benefactions have been consolidated into one fund, and are applied for the encouragement and reward of deserving students.

The income available every year at this College for Scholarships, Exhibitions, Sizarships, and Prizes, is between £1200 and £1300.

KING'S COLLEGE.

The statutes of this College, framed under the powers of the Cambridge University Act (19 and 20 Vict. cap. 88), contain a provision to the effect that so much and such parts of the new regulations shall be brought into operation from time to time, as may be deemed most expedient, according as existing interests under the old statutes, shall expire or otherwise determine.

The new statutes ordain that there shall be forty-eight Scholarships: of these twenty-four are to be appropriated to the scholars of the College of King Henry VI., at Eton, and to be called Eton Scholarships. There is an Examination annually held at Eton, in the end of July, after which the

Electors, three of whom are from Eton and three from King's College proceed to elect to the vacant Scholarships such Candidates as have shewn sufficient merit. If any Scholarship shall fail to be filled up, from the want of sufficient merit in any of the Candidates, that Scholarship may be disposed of as an open Scholarship. The remaining twenty-four are to be called Open Scholarships, and to be given according to merit.

Of the twenty-four open Scholarships, twelve are to be open to all candidates who are British subjects, and under twenty years of age at the time of Examination; and the other twelve to undergraduates of the College.

The Scholarships are to be tenable till the scholars have attained the standing of Master of Arts, or until they become Fellows of the College, or of any other College.

When all the Scholarships are filled up, about one-third of them will be held by Bachelors of Arts, and the remaining two-thirds by Undergraduates.

The value of each of the sixteen Eton Scholarships held by Undergraduates during residence will include a payment of £80 a-year, with rooms, commons, and tuition free, in amount not less than £150 a year. The eight Eton Scholars, Bachelors of Arts, if in residence, will continue to receive the £80 a year with rooms and commons free; but if non-resident, only the payment of £80 a-year while the Scholarships are tenable.

In the same manner, of the sixteen open Scholarships held by Undergraduates, during residence, each is to receive £80 a-year with tuition free, which amounts to £98 a-year.

It is provided by the statutes, that the additional privilege of rooms and commons is to be extended to the Open Scholarships so soon as the circumstances of the College will permit. The Open Scholarships held by Bachelors of Arts, will, if they are resident, be of the value of £84. 10*s.* a-year, but only of £80 if they are non-resident.

All Members of the College who have taken the degree of Bachelor of Arts, Law, or Medicine, and whose standing after such degree does not exceed three years are eligible to Fellowships.

In the year 1865, the College was opened for the admission of other students, as pensioners, besides the Eton Scholars.

An entrance Examination in the Easter Term has been instituted for the admission of students. Those candidates who satisfy the Examiners will be admitted to reside as pensioners in the following October.

Exhibitions. Two Exhibitions, each of £50 a-year, with tuition free, tenable for four years, were given to the two candidates under twenty years of age, who most distinguished themselves in mathematics and physics at the Entrance Examination of 1865. Another offer was made by the College in 1866 of two Exhibitions of £50 each and tenable for three years to the best Classical and Mathematical Candidates for admission to the College.

The income available at this College for Scholarships, Exhibitions and Prizes, when all the regulations under the new statutes are brought into operation, will, at least, be between £5800 and £5900.

QUEENS' COLLEGE.

By the new statutes it is ordered that there shall be at least fourteen open Scholarships on the foundation, and that the number may be increased or diminished if the revenues of the College become increased or diminished.

Of these fourteen Scholarships there are four of £50, five of £40, and five of £30 a-year.

It has been agreed by the President and Fellows of the College, that if there be any students deserving of Scholarships besides those which have been founded under the new statutes, they shall have supernumerary Scholarships; and that if any students be deemed worthy of Scholarships of greater value than those above mentioned, their Scholarships shall be augmented at the discretion of the President and Fellows.

The number of scholars at present is seventeen.

All the Scholarships are perfectly open, and are tenable till the Scholar is of sufficient standing to be admitted to the degree of B.A.

The scholars are elected out of the most distinguished students of the College, according as they may have acquitted themselves at the general College Examination.

Every year, there is an Examination for two Scholarships, open to all persons under twenty years of age, who shall not have commenced residence at the University. These Scholarships are each of the value of £40 a-year. One of them is awarded for proficiency in mathematics, and the other for proficiency in classics.

Exhibitions. There are two Exhibitions, each of £20 a-year, with a preference to the sons of poor clergymen. There is another of £20 a year, awarded to that undergraduate who passes the best Examination in classics at the Christmas Examination, provided he be considered worthy of such distinction.

The Sandys' Exhibitioner of £12 a-year is appointed by the Rev. J. Sandys during his lifetime.

There is also an Exhibition of £15 a-year attached to the office of Librarian, which is held by an undergraduate.

Besides the Scholarships and Exhibitions, the President has at his disposal funds to the amount of £130 per annum, by which deserving students of limited means are assisted.

The income available every year at this College for Scholarships, Exhibitions, and Prizes is between £700 and £800.

ST. CATHARINE'S COLLEGE.

Under the powers of the new statutes the Scholarships of this College have been consolidated, and their value augmented by the conversion of some of the bye fellowships. All the former restrictions originally attached to the Scholarships are abolished, and all are now open to Candidates from any school or place of birth.

There are at present two Scholarships of £50, ten of £40, and nine of £25 a-year, besides an additional Scholarship which will arise from the termination of the present tenure of a Bye-fellowship.

The scholars are chosen from the members of the College, after the College Examination; and the Scholarships are tenable till the Scholar has completed the degree of B.A., but a scholar of distinguished merit may be permitted to retain his Scholarship until he is of standing for the degree of M.A.

A deserving scholar may be promoted to a Scholarship of greater value, and on account of distinguished excellence, a scholar may be elected to a second Scholarship.

Two Scholarships have been opened for the competition of students who have not been matriculated, nor admitted at any other College. One of them is of £50, and the other is £40 a-year, with rooms rent free; and these Scholarships are tenable until the general Examination for Scholarships in the College.

There is one Sizarship at the College, in the gift of the Master. The present value of it is £50 a-year, with rooms rent-free.

The office of Librarian is held by an undergraduate, the emoluments of which are £20 a-year and rooms rent free. The Bible Clerk, also an undergraduate, receives his commons, with rooms rent free.

The income available every year at this College for Scholarships, Exhibitions, Sizarships, and Prizes, is between £1000 and £1100.

JESUS COLLEGE.

The Scholarships of this College have been consolidated and considerably augmented.

Under the revised statutes it is ordained that there shall be fifteen open Scholarships on the foundation of the College, the holders of which are to devote themselves to the study of natural and revealed religion, mathematics, and natural philosophy, classical literature, and other subjects of study, ordered by the regulations of the University.

Of these fifteen Foundation Scholarships, five are each not less than £50, six not less than £30, and four not less than £20 a year.

Besides these, there are fifteen other Scholarships, ranging from £30 to £40 a-year, and appropriated to the orphans of clergymen, or in default of such candidates, to the sons of living clergymen.

Also, one of £50, and one of £15 a-year, appropriated to the sons of clergymen, with a preference to an orphan, for the latter.

The Foundation Scholarships are tenable with any other Scholarships or Exhibitions, open or restricted.

There are two Scholarships, each of the value of £30 a-year, open to the competition of students who have not been matriculated. The Examination takes place early in October, and one is given for proficiency in classics, and the other for proficiency in mathematics.

Exhibitions. One of £60, or two of £30 a-year, for students from the Grammar School of Loughborough.

Two, each of the value of £50 a-year, for students educated at the Grammar School at Tunbridge or Sevenoaks.

Two, each of £15 a year, tenable by the orphans of clergymen, from the time of admission to the degree of B.A. till that of M.A.

Besides the Scholarships, the Master and Fellows grant to deserving students of the College additional rewards, in the form of money payments not exceeding £12 per annum each.

The income available every year at this College for Scholarships, Exhibitions, and Prizes, is between £1300 and £1400.

CHRIST'S COLLEGE.

The Scholarships on the original foundation of this College, as well as those on the foundations of other benefactors, have been consolidated and considerably augmented in value. The Master and Fellows have assigned one fifth part of the divisible revenues of the College, for the payments to be made to the scholars on the foundation of the College, in addition to the income arising from the other benefactions left for the maintenance of scholars.

Under the provision of the new statutes the Scholarships are open to all the Queen's subjects, without any restriction or appropriation.

Of the twenty-nine Scholarships, twelve are each of £70, six of £50, and eleven of £30 a-year.

Besides the twenty-nine Scholarships there are six Exhibitions; two each of £50 a-year, with a preference to students from Giggleswick school.

Two each of £30 a-year, with a preference to students from Kirkby Lonsdale school.

One of £30 a year, with a preference to a student from Skipton School.

One of not less than £20 a-year, with preference, first to a student from Kirkby Lonsdale school, and secondly to a student from Sedburgh school.

The election of Scholars and Exhibitioners is made from the most distinguished students in residence, after the general College Examination in the Easter Term. A student may be a candidate in each year of his undergraduateship.

At any Examination for Scholarships and Exhibitions, in the case of there being no properly qualified candidate from a preferred school, for an Exhibition, it will be for that time considered open, and a student gaining, by open competition, any of the Exhibitions except the last-mentioned, will be regarded as a Scholar of the College.

The Master and Fellows are authorized by the statutes to confer two Scholarships on the same student, if they consider him deserving.

After the Examination in June, 1866, the sum of £980 was assigned to the Scholars for the year 1866-1867.

Students of the third year. One was elected to a Scholarship of £30 a year, and another was transferred from a Scholarship of £30 to one of £50 a year.

Students of the second year. One was elected to a Scholarship of £30 a year, and two others were transferred from Scholarships of £70 to others of £100 a year.

Students of the first year. One was elected to a Scholarship of £50 a year, another to a Scholarship of £100 a year, and six to Scholarships of £30 a year.

Also one was transferred from a Scholarship of £50 to one of £70; and two from Scholarships of £70 to others of £100 a year.

There is besides, every year, an election of Scholars and Exhibitioners from students who have not commenced residence in the University.

The subjects of the Examination are classics and mathematics. In the year 1866, out of the candidates who presented themselves, seven were elected either to Scholarships or Exhibitions, viz.—two of £70, two of £60, two of £50, and one of £30 a-year.

The Tancred Studentships, four in number, are each of the annual value of £100, founded by Mr. Tancred for students of divinity.

These Studentships are subject to the same laws and regulations as the four Studentships founded by Mr. Tancred at Gonville and Caius College for students of medicine.

Forms of petition, and all information respecting the Tancred Studentships may be obtained from B. J. L. Frere, Esq., Clerk to the Governors and Trustees, 28, Lincoln's Inn Fields, London.

The order of Sizars is not recognized in the new statutes of the College. Four Sizars, however, are generally maintained, being selected by the Master and Fellows from the pensioners of the College, not only on account of their moral and intellectual qualifications, but also with regard to their need of assistance for proceeding through the University. The emoluments of a sizar may be considered at about £50 a-year.

Besides the above-named Scholarships and Exhibitions there is an income arising from eight small benefactions, of between £50 and £60 a-year, which is annually given in Exhibitions amongst the most deserving students of the College.

The income available every year at this College for Scholarships, Exhibitions, Sizarships and Prizes is between £1800 and £1900.

ST. JOHN'S COLLEGE.

The new statutes of this College decree that there shall be sixty open Scholarships on the foundation of the College, of the annual value of not less than £50 each.

The foundation scholars are chosen from the students of the College, with special reference to their learning, ability, and moral character. The intellectual qualifications of the candidates are tested by an Examination.

Besides the Foundation Scholarships, there are eight minor Scholarships, each of them not less in value than £50 a-year, and tenable for not more than two years. Four of these minor Scholarships are open every year to students under twenty years of age, who have not yet commenced residence in the University, or who are in the first term of their residence. The election of scholars after Examination, takes place in the Easter Term. It may be added, that two of the four minor Scholarships which are filled up every year, are usually raised from £50 to £70.

Two law studentships have been founded, each of the value of £150 a-year, (hereafter to be augmented to four), and are tenable for four years, and open to the competition of the most meritorious Graduates of this College in Arts or Law, who shall *bona fide* intend to prepare themselves for practice in the profession of the Law.

The sum of £360 is yearly distributed in Exhibitions to the most deserving students (called Wood's Exhibitioners), regard being had both to their pecuniary circumstances as well as to their moral and intellectual qualifications.

In the same manner, about £550 is yearly distributed to deserving students, called Hare's Exhibitioners.

Besides these perfectly open Scholarships and Exhibitions, the following Exhibitions are attached by way of preference to certain schools.

Four of £50 each, two of £32. 17*s*. 6*d*. each, and one of £17. 10*s*., for Scholars from Shrewsbury school.

Four of £50 each, and eight of £40 each, with a preference to Hereford school.

Four of £50 each, with a preference to Manchester school.

Four of £50 each, with a preference to Marlborough school.

Six of £33. 6*s.* 8*d.* each, with a preference to Sedburgh school.

Four of £40 each, with a preference to Pocklington school.

One of £20, by the nomination of the Marquis of Exeter, with a preference to Stamford school.

One of £10, by the nomination of the Marquis of Salisbury, with a preference to Westminster or Hoddesdon school.

Two of £30, with a preference to Peterborough and Oundle schools.

One of £18, with a preference to Bury St. Edmund's school.

One of £20, with a preference to Sutton Valence school.

One of £40, with a preference to Grantham school.

Three of £30, with a preference to Durham school.

Two of £25, with a preference to Exeter school.

One of about £63 a-year, for scholars educated at Bowness School, with preference to natives of Applethwaite or Undermillbeck. The Trustees of the school are the Electors.

Four of £32 each, with a preference to Oakham and Uppingham Schools.

Two of £35 each, for students from Dedham school.

One of £40, for students from the schools of Bangor, or of Ruthin.

If no candidates of sufficient merit are found from any of the places of education to which a preference is reserved for any Exhibition, the Master and Seniors, for that vacancy, may throw open the vacant Exhibition to general or extended competition, in such a manner as they may think desirable.

There is a Hebrew Scholarship of £32 a-year, and a Divinity Studentship of about £100 a-year. These are only tenable by students after their admission to the degree of B.A.

The examination of candidates for the Exhibitions which are limited to certain schools, takes place at the same time as the Examination for Sizarships, and the subjects for examination are the same as the subjects for Sizarships.

There are nine sizars on the foundation, usually called proper sizars, who are chosen from the other sizars, a preference being given to those who have ranked high in the classics at the general Examination of the College. The proper sizars have their commons free, and enjoy other emoluments and advantages.

The College admits annually not more than eighteen other sizars, who are not on the foundation of the College. They are chosen after an Examination which takes place early in the Michaelmas Term every year. The ordinary sizars have an allowance for commons, and some other advantages.

The income available every year at this College for Scholarships, Exhibitions, Sizarships and Prizes is between £6600 and £6700.

MAGDALENE COLLEGE.

By the new statutes of this College, the restrictions on the Scholarships have been removed, (excepting those for which the right of preference is reserved to certain schools,) and the total amount of such Scholarships and Exhibitions now forms a general fund for open Scholarships. This fund is augmented from the revenue coming to the College by the abolition of bye Fellowships, so that there will be hereafter three open Scholarships not less than £60, three not less than £40, and six not less than £20 a-year each.

The election of scholars takes place after the annual College Examination, in the Easter Term.

Three Scholarships, one of £60, and one of £40, and one of £20 a-year, are annually open for the competition of candidates who have not commenced residence in the University.

The following Exhibitions are under the same regulations and restrictions as heretofore, except that in case of a vacancy of any Exhibition for which no candidates of sufficient merit, coming from the School or Schools, to which candidates are restricted, shall offer themselves; it shall be competent for the Master and Fellows to throw the same open to general or extended competition as they may think advisable.

Exhibitions. Four, each of £63 a-year, with a preference to Shrewsbury School.

Two, each of £30 a-year, for students of Shrewsbury School with a first preference to those born in St. Chad's Parish in Shrewsbury, and a second preference to those born in the county of Salop.

Three, each of £70 a-year, for students from Wisbeach school.

Four, each of £70 a-year, for students from Leeds, Halifax and Heversham schools.

The Pepysian Benefaction, value £50 a-year, is usually bestowed by the Master upon the most deserving of the poor students of the College.

There are four sizars admitted at this College, who enjoy certain emoluments and advantages.

The income available every year at this College for Scholarships, Exhibitions, Sizarships and Prizes is between £1400 and £1500.

TRINITY COLLEGE.

There are seventy-two scholars on the foundation of the College, who are chosen from the students of the College in their second or third year of residence. They are chosen with especial reference to their learning, ability, and moral character. Their intellectual qualifications are tested by an Examination, and the election takes place on the Monday after Easter week.

The pecuniary emoluments of a scholar depend, in some degree, on the period he is in residence during the year, and may be considered about £60 a year.

Besides the Foundation Scholars, there are six minor Scholars chosen every year. The minor Scholarships are open to all students under twenty years of age, who have not commenced residence in the University, or who are in their first term of residence. They are each of the value of £50 a year, and are tenable for three years from the day of election, or until the scholar be elected to one of the Foundation Scholarships of the College. The Examination before election is in Classics and Mathematics.

Exhibitions. The Sheepshanks Astronomical Exhibition of £50 a year is open to all undergraduates in the University, but the Exhibitioner, if not, must become, a member of Trinity College.

Two or three yearly each of the value of £40 a-year, for students from Westminster School.

Five, each of the value of £13 a-year, for students from St. Paul's School.

Three each, of the value of £6. 13*s.* 4*d.* per annum in the gift of the College.

One of £3. 8*s.* 6*d.* per annum for a scholar from Lynn Regis School.

Two yearly, one of £100, and one of £80 a-year for students from St. Paul's School.

One of £28, for a student of the name and kindred of the founder, the Rev. R. B. Podmore. In default of such, for a native of the County of Salop, educated at Shrewsbury School.

One of £45 a-year, for a student from Heversham School.

One of £35 a-year, for a student from Cheltenham College.

Two, for students from Combrook or Warwick Grammar School. The payments of these Exhibitions are made by the representatives of the Foundress, Lady Verney.

There are sixteen foundation sizars in the College, who are appointed from the subsizars in the order in which they stand in the classes at the annual College Examination.

The total emoluments of a foundation sizar may be stated at about £60 a year; besides an award of £25, £15, or £10 every year, according as he may hold a place, in the first, second, or third class, at the Annual College Examination.

Subsizars are eligible also to these awards, if they gain a place in either of the classes to which the awards are assigned.

The income available every year at this College, for Scholarships, Exhibitions, Sizarships and Prizes is between £8900 and £9000.

EMMANUEL COLLEGE.

The revised statutes of this College ordain that there shall be twelve open Scholarships, each of £60, on the foundation of the College, and five of £30 a year.

The Scholars are elected from the students of the College, who are of good character and ability, and who are qualified by their proficiency in literature and science, as determined at the annual College Examination.

Two Scholarships, each of £60 a year, and two Exhibitions, each of £50, both tenable for one year, are open to the competition of students under twenty years of age, who have not commenced residence in the University.

The Scholarships are tenable till the holders of them are of standing to be admitted to the degree of B.A., and, with the permission of the Master and Fellows, to the degree of M.A.

There are also five Scholarships, each of £30 a year, designed for the encouragement and support of young students in Divinity, with a preference, cæteris paribus, to the sons of orthodox clergymen.

These Scholarships are awarded to students in the second year of residence, and may be held with another Scholarship.

There are also four Scholarships, each of £10 a-year, tenable by relations of the Founder, Sir Wolstan Dixie, or by students educated at Market-Bosworth School. The heirs of the Founder nominate, and the College admits the nomination.

Exhibitions. Two each of £50 a-year, with a preference to students from the Grammar Schools of Derby and Ashby-de-la-Zouch.

Four of £32 each a year, with a first preference "to the sons of Godly ministers," and a second to students from the Grammar Schools of Oakham and Uppingham.

One of £16 a-year, with a preference to a student from the Durham or Newcastle School.

In default of any competent candidates from that School, entitled to a preference in the election for that turn on the occasion of a vacancy, the Exhibition then vacant shall be treated as open to the general competition of the students of the College.

One of £10, with preference to a medical student.

The revised statutes do not recognize the class of sizars as members on the foundation of the College. Four sizars are admitted. They are chosen from the pensioners, after an Examination, at the end of the first term of residence; due regard being had to their pecuniary circumstances.

Several small Exhibitions have been consolidated into one general fund, the proceeds of which are applied from time to time, by the Master and Fellows of the College, at their discretion, for the support and encouragement of poor and deserving students.

The income available every year at this College for Scholarships, Exhibitions, Sizarships, and Prizes, is between £1500 and £1600.

SIDNEY SUSSEX COLLEGE.

It is provided by the new statutes, that the value of the Foundation Scholarships shall be at least £40 a-year, and the number shall not be more than double the number of the Fellowships. The number of Fellowships at present is nine.

Every vacancy of a Scholarship is filled up after an Examination of the candidates, which takes place in the Easter Term.

There are also six Senior Taylor Scholarships, each of £50 a year, with rooms rent-free; and ten Junior Taylor Scholarships, each £40 a year.

These Scholarships are awarded for proficiency in mathematics and natural science.

The Senior Scholarships are awarded after the College Examination in the Easter Term. The Junior Scholarships are offered for the competition of students who are about to commence residence in the University.

Exhibitions. Three of £60 a year each, with a preference to students from Tiverton School.

Five of about £45 a year each, for the sons of Clergymen who intend to become clergymen. A preference is reserved for students from Grantham and Oakham Schools.

Four of £32 a year each, with a preference to students from Oakham and Uppingham Schools.

Two of £12 a year each, for the orphans and sons of clergymen.

One of £12 a year, on the nomination of the Master of the College.

One of £10 in the gift of the Master and Fellows.

Two of £12 each in the gift of the Company of Haberdashers.

Under the powers of the new statutes, certain Scholarships and Exhibitions have been opened for general competition among students who have not commenced residence in the University, or who shall be in the first term of such residence, though their names may not be on the boards of the College.

The following are the Scholarships and Exhibitions open for competition before residence in October, 1866:—

One of £80 a year for classics and mathematics; and one of £40, for classics. These are restricted to students under twenty years of age.

Two, each of £40 a year, for mathematics; and two of £40 a year, for natural science or mathematics. These are not restricted to students under twenty years of age.

One or more of £32 a year, according to default of properly qualified candidates from Schools which have a preference.

The new statutes make no provision for the maintenance of sizars on the foundation of the College. The four sizars, however, are continued, and one is selected every year from the candidates after Examination in October.

The income available every year at this College for Scholarships, Exhibitions, Sizarships, and Prizes, is between £2100 and £2200.

DOWNING COLLEGE.

This College, by the new statutes, is required to have at east ten open Scholarships on the Foundation. All vacancies are filled up from among the students of the College, or from among the students of the University. The election is decided entirely by an Examination of the candidates, and considerable importance is attached to any special proficiency in the legal or medical subjects. The value of these Scholarships is £50 a year, with rooms and commons, and they are tenable for three years.

There are also four minor Scholarships, each of £40 a year, open to the competition of students who have not commenced residence in the University, or who have not resided one term in any other College, and tenable for two years, or until the holder is elected to a Foundation Scholarship.

In the minor Scholarships the Examination is chiefly in classics and mathematics, but some weight is given to proficiency in the French and German languages.

The income available every year at this College for Scholarships, Exhibitions, and Prizes, is between £800 and £900.

UNIVERSITY SCHOLARSHIPS AND PRIZES.

The Craven Scholarships, now five in number, are awarded after Examination in Classical Literature to the most distinguished undergraduates. They are each £80 a year, and may be held for seven years if the Scholar continues to be a member of the University.

The Battie Scholarship is also given for Classics. Its value is between £30 and £35 a year.

Sir William Browne's Scholarship, £21 a year, is a Classical Scholarship, tenable for seven years: but it cannot be held with any other University Scholarship.

The Davies' Scholarship is tenable for the same period as the Craven Scholarships. The Rev. Jonathan Davies, D.D., formerly Fellow of King's and afterwards Provost of Eton, remembering that he had himself obtained one of the University Scholarships, bequeathed the sum of £1000 in the 3 per cents. to found a Classical Scholarship, to be called "Dr. Davies' University Scholarship" for the greatest proficient in Classical Learning.

The Pitt Scholarship is under the same regulations as the Craven Scholarships. The emolument of this Scholarship arises from the interest of £1500.

The Porson Scholarship is also a Classical Scholarship, tenable for four years; and is not of less value than £60 a year.

The Bell Scholarships, eight in number, are restricted to the orphans and sons of clergymen, and are tenable for four years.

The payments for these Scholarships arise from £15,200 Stock, in the 3 per cents.

The Examination is not confined to Classical Literature, but includes Mathematics and Natural Philosophy, as well as Theology.

The Sheepshanks Astronomical Exhibition is open to all undergraduates in the University, but the successful candidate, if not a member of Trinity College, is required to become a member of that College.

The Chancellor's Medal for English Verse is a gold medal conferred annually upon a resident undergraduate who shall compose in English the best Ode, or the best Poem in Heroic Verse.

Any undergraduate, who has resided one term, may be a candidate for the prize, and the successful candidate is required to print his poem, and recite it in the Senate House at the Commencement.

The Camden Medal is a gold medal given every year to that undergraduate who composes the best Exercise in Latin Hexameter Verse.

Any undergraduate who has resided not less than two terms may become a candidate for the prize, and the successful candidate is required to print his Exercise and recite it in the Senate House at the Commencement.

Sir William Browne's Medals are three gold medals, each of the value of five guineas, awarded to three undergraduates on Commencement-day in the Senate House, after the Exercises have been read. To the first, who writes the best Greek Ode in imitation of Sappho. To the second, who writes the best Latin Ode in imitation of Horace. To the third, who shall produce the best Greek Epigram after the manner of the Anthologia, and the best Latin Epigram after the model of Martial.

If in any year the best Greek Epigram and the best Latin Epigram shall not be produced by the same candidate, two medals shall be given in that year, each of the value of two guineas and a half; one to the candidate who produces the best Greek Epigram, and the other to the candidate who produces the best Latin Epigram.

The Porson University Prize is annually given to an undergraduate who makes the best translation into Greek Verse, of a selected passage in some play of Shakspeare, Ben Jonson, Massinger, or Beaumont and Fletcher.

The successful candidate is required to print his Exercise, and recite it in the Senate House at the Commencement.

The prize consists of Greek books purchased from the yearly proceeds of £400, invested in the Navy 5 per cents.

The Norrisian Prize was a benefaction of £12 a-year left by the founder, Mr. Norris, for the best Essay on a Theological subject.

In 1858 a new statute was framed, which repeals the order of the Founder, and directs for the future that the prize shall be given once every five years, and it shall be the sum of the annuities of the five years preceding the adjudication.

The candidates are required to be graduates of the University, and of not more than thirteen years' standing from their first degree, when the Essays are sent in.

. The Hulsean Prize is awarded every year for the best Dissertation in the English language, "On the Evidences in general, or on the Prophecies, or Miracles in particular, or any other particular argument, whether the same be direct or collateral proofs of the Christian Religion, in order to evince its truth and excellence."

Any persons who are not of standing sufficient for the degree of Master of Arts may be candidates for this prize. In consequence of the improvement of the rental of the estates left by Mr. Hulse, the premium has been raised from time to time, and by the recent legislation, it is fixed at one-tenth of the net proceeds of Mr. Hulse's benefaction. The successful candidate is required to print and publish his Dissertation. The value of the premium is about £100.

Mr. Hulse directed that certain clauses of his will should always be prefixed to the Prize Dissertation, and desired that the following passage might be added: "May the Divine blessing for ever go along with all my benefactions; and may the greatest and best of Beings, by His all wise Providence and gracious influence, make the same effectual to His own glory and the good of my fellow creatures."

Sir Peregrine Maitland's Prize is a triennial prize for an English Essay, on some subject connected with the Propagation of the Gospel, through Missionary Exertions in India, and other parts of the heathen world. Candidates for the

Prize must be Bachelors of Arts under the standing requisite for the degree of Master of Arts, or Students of Civil Law or Medicine, of not less than four, nor more than seven years' standing. The successful candidate receives the interest of the fund of £1000, accruing in three years, and is required to print and publish his Essay.

The Burney Prize is an annual prize for an Essay in English "On some Moral or Metaphysical subject, on the Existence, Nature, and Attributes of God, or on the Truth and Evidence of the Christian Religion." Candidates are required to be Bachelors of Arts, in their first year, and the successful candidate must print and publish his Essay.

The premium for this Prize arises from the income of £3,500, invested in the reduced 3 per cent. Stock.

The Le Bas Prize is a premium awarded yearly for the best Essay in English on some subject of General Literature, but such subject is required to be occasionally chosen with reference to the History, Institutions, and probable destinies and prospects of the Anglo-Indian Empire. The candidates must be Bachelors of Arts under the standing for Master of Arts, or Students in Law or Medicine, of not less than four, nor more than seven years' standing.

The premium arises from the income of £1920 Stock in the 3 per cent. Consols.

The Hare Prize is a premium awarded every four years to the author of the best English Dissertation on some subject taken from Ancient Greek or Roman History, political or literary, or from the History of Greek or Roman Philosophy. Candidates for the prize must be actual members of the University, and graduates of not more than ten years' standing from admission to the first degree, at the time when the Exercises are directed to be sent in.

The Dissertation is required to be printed by the author and published. The premium arises from £500 Stock invested in the 3 per cent. Consols.

The Kaye Prize is also a premium given every fourth year to a graduate of not more than ten years' standing from his first degree, who shall write the best English Dissertation upon some subject or question relating to Ancient Ecclesiastical History, or to the Canon of Scripture, or important points of Biblical Criticism.

The successful candidate is required to print and publish his Dissertation. The premium consists of four years' interest of £500 Stock in the 3 per cent. Consols.

The Tyrwhitt Hebrew Scholarships are six in number, three of £30 a year and three of £20 a year.

The Examination for these Scholarships is in the Hebrew Scriptures of the Old Testament, and in other Hebrew works, and in such exercises as may be judged most likely to assist and advance the knowledge of the Sacred Writings.

The candidates for these Scholarships must be Bachelors of Arts who are not of sufficient standing to be created Masters of Arts, and students in Civil Law and Medicine of not less than four, or more than seven years' standing.

In addition to the Scholarships, gratuities have been occasionally awarded after the Examination to such candidates as have appeared deserving, in consequence of their knowledge of the Hebrew Language.

The three Crosse Theological Scholarships are open to Bachelors of Arts in their first year, and are tenable for three years. The payments of these Scholarships arise from a benefaction of £2000. The Examination includes the Holy Scriptures in their original tongues, Hebrew and Greek, Ecclesiastical History, the earlier and later Heresies, and such other subjects of useful enquiry, as may be thought most likely to assist in the formation of valuable characters, fitted to sustain and adorn the cause of true Religion.

The Carus Greek Testament Prizes were instituted for the encouragement of the accurate study of the Greek Testament. The Examination embraces translations and questions on the criticism and interpretation of the Greek Testament.

There are yearly two prizes, one open to undergraduates, and the other open to Bachelors of Arts and students in Law and Medicine, of not more than seven years' standing.

The proceeds of the fund, £1000 in the 3 per cent. Consols, after the Examiners have been paid, are to be divided into two equal parts, and to be expended in standard Theological books as prizes for the two successful candidates.

The Scholefield Prize is designed for the encouragement of the critical study of the Holy Scriptures.

The prize, consisting of the dividend of £500 Stock in the 3 per cent. Consols, is given every year to that student among the Middle Bachelors who, being in the first class of honours in the Theological Examination of that year, shall be judged by the Examiners to have shewn the best knowledge of the Greek Testament, and the Septuagint version of the Old Testament.

The Chancellor's Medal for Legal studies, is an annual gold medal, awarded every year to that student who passes the best Examination in the Elements of Roman Civil Law, the Principles of International Law, the Constitutional History and Constitutional Law of England, and the Principles of the General Law of England.

The Examination is open (1) to all students who, having passed the Examinations entitling them to be admitted Bachelors designate in Arts or Law, are not of sufficient standing to be created Masters of Arts or Law; (2) to all Students, who having taken the degree of Bachelor of Arts *jure natalium*, are not of sufficient standing to be created Master of Arts; (3) to all students in Medicine of not more than seven years' standing from Matriculation, who have passed both the Examinations, and kept the exercises necessary for the degree of M.B.

The Adams Prize is given every two years for the best Essay on some subject selected by the adjudicators of the Prize, which may be on any question in Pure Mathematics, Astronomy, or other branch of Natural Philosophy.

Any graduate of the University may become a candidate for this prize, and the successful candidate is required to print and publish his Essay, and will receive the premium of about £130.

The Sedgwick Prize is designed for the encouragement of the study of Geology among the resident Members of the University, and in honour of the Rev. Adam Sedgwick, Woodwardian Professor of Geology. The prize will be awarded every third year for the best Essay on some subject in Geology or the kindred Sciences.

Any Graduate of the University may be a Candidate, if he has resided sixty days during the twelve months preceding that first day of October on or before which the Essay must be sent in. The subject of the first Essay was given out in the Lent Term, 1865, and the candidates must send in their exercises on or before the first day of October, 1867.

The value of the Prize consists of three years' income of £500, Scinde Railway Stock.

MINOR SCHOLARSHIP EXAMINATION.

TRINITY COLLEGE. *June*, 1861.

I.

Translate these passages:

1. *From* Ἔστι δὲ πολλὰ ἔθνεα Ἰνδῶν, ...
to . . . . νοῦσον πίπτοντα πάντα κτείνουσι.
HEROD. III., 98, 99.

2. *From* Καὶ τοῖς μὲν ἄλλοις ἐφαίνετο . . . .
to . . . . καταφυγὴν εἶναι καὶ ἐκείνων σωφρονιστήν.
THUCYD. VIII., 48.

Describe the state of parties at Athens at this time. What was the subsequent history of Phrynichus? Mention any other famous Athenians bearing the same name.

3. *From* Ἐν δ' ἄροσις λείη· μάλα κεν βαθὺ . . . .
to . . . . ἀποβρίξαντες ἐμείναμεν Ἠῶ δῖαν.
HOMER, *Odyss.*, IX., 134—151.

4. *From* Τοσαῦτα φωνήσασα συντόνῳ χερὶ . . . .
to . . ὠρφανισμένος βίου.
SOPH., *Trach.*, 923—942.

Write a brief commentary on this passage, explaining grammatical and other difficulties.

II.

Translate:

I. *From* Malus Civis, improbus consul, seditiosus homo . . . .
to . . . . prospicere atque explorare potueris.
CICERO, *In Verrem*, I. XIV. XV. 37—39.

1. Give a brief account of (1) Carbo and of (2) Sulla, with dates of the principal events in their lives.

2. Mention in proper order the towns which lay on the road between Rome and Beneventum.

II. *From* Tib. Claudio quintum, Sex. Cornelio . . . .
to . . . . Hactenus Vitellius voluerat.
TACITUS, *Ann.* XII. 41, 42.

Write notes explaining the sentences printed in italics.

Obvii inter se Nero Britannicum nomine, ille Domitium salutavere.

...quam imperatore genitam sororemque ejus qui rerum potitus sit et conjugem et matrem fuisse unicum ad hunc diem exemplum est.

III. *From* Hæc, et quæ poterunt reditus....
to ....rege temperante cælitum.
HORACE, *Epod.* XVI. 35—56.

IV. *From* Sed vatem egregium cui non sit....
to ....nihil gemeret grave buccina.
JUVENAL, VII. 53—71.

Quote from Virgil and Horace the passages to which allusion is here made. Does Juvenal's assertion agree with what Horace says of himself, and is it generally true? Give examples.

III.

1. For Latin Prose:

The philosophy which affects to teach us a contempt of money does not run very deep; for, indeed, it ought to be still more clear to the philosopher than it is to ordinary men, that there are few things in the world of greater importance. And so manifold are the bearings of money upon the lives and characters of mankind, that an insight which should search out the life of a man in his pecuniary relations would penetrate into almost every cranny of his nature. He who knows, like St. Paul, both how to spare and how to abound, has a great knowledge: for if we take account of all the virtues with which money is mixed up,—honesty, justice, generosity, charity, frugality, forethought, self-sacrifice,—and of their correlative vices,—it is a knowledge which goes near to cover the length and breadth of humanity: and a right measure and manner in getting, saving, spending, giving, taking, lending, borrowing, and bequeathing, would almost argue a perfect man.

2. For Latin Hexameters:

They couch'd their spears and prick'd their steeds and thus,
Their plumes driv'n backward by the wind they made
In moving, all together down upon him
Bare, as a wild wave in the wide North-sea,
Green-glimmering toward the summit, bears, with all

Its stormy crests that smoke against the skies,
Down on a bark, and overbears the bark,
And him that helms it, so they overbore
Sir Lancelot and his charger, and a spear
Down-glancing lamed the charger, and a spear
Prick'd sharply his own cuirass, and the head
Pierced thro' his side, and there snapt, and remained.

3. For Greek Prose:

But then, this happy temper and these good faculties rather preserved him from having many enemies, and supplied him with some well-wishers, than furnished him with any fast and unshaken friends; who are always procured in courts by more ardour, and more vehement professions and applications, than he would suffer himself to be entangled with. So that he was a man rather exceedingly liked, than passionately loved: insomuch that it never appeared, that he had any one friend in the court, of quality enough to prevent or divert any disadvantage he might be exposed to. And therefore it is no wonder, nor to be imputed to him, that he retired within himself as much as he could, and stood upon his defence without making desperate sallies against growing mischiefs; which, he knew well, he had no power to hinder, and which might probably begin in his own ruin. To conclude; his security consisted very much in the little credit he had with the King; and he died in a season most opportune, and in which a wise man would have prayed to have finished his course, and which in truth crowned his other signal prosperity in this world.

IV.

1. Make a triangle whose sides shall be three given straight lines any two of which are together greater than the third. Whence arises the necessity for this limitation? Where, in your investigation, do you make use of it?

2. Find, as Euclid does, the difference between the square of the side of a triangle subtending one of the acute angles and the squares of the sides containing it.

3. Draw a straight line touching two given circles.

4. Is a ratio of greater inequality increased or diminished by adding the same quantity to both its terms? Can you see this at once by taking an extreme case?

5. Explain the difference between interest and discount;

and find the difference between the interest of £350 for 15 months at $4\frac{1}{2}$ per cent. and the discount on £350 for the same time at the same rate of interest.

6. In an arithmetical progression, given a, s, d; find n. Explain the double answer in the cases when n being integral has two positive values, or one positive and one negative. If n is fractional, what is its meaning? Illustrate by the following instances: find the number of terms of the series 3, 4, 5...which make 18, and of the series 7, 6, 5...which make 22.

7. Find the sum of n terms of the series

$$1.2.3 + 2.3.4 + 3.4.5 + \&c.$$

8. Having given in a triangle, $b = 9{\cdot}5$, $c = {\cdot}5$, $A = 36°$; find the remaining angles,

$$\log\tan 16°.18' = 9{\cdot}4660078, \qquad \log\cot 18° = 9{\cdot}5117760,$$
$$\log\tan 16°.19' = 9{\cdot}4664765, \qquad \log 3 = {\cdot}4771213.$$

9. Assuming Demoivre's theorem for an integer, prove it for a fraction; and apply it to find the values of $(1)^{\frac{1}{5}}$.

10. The section of a right cone made by a plane which is parallel to a plane touching the cone along its slant side, is a parabola.

A parabola being traced on paper, shew how its axis and directrix may be found.

11. Find the locus of the middle points of all chords in an ellipse at a given distance (p) from its centre.

12. Trace the curves $\frac{y}{a} = \frac{x(x-1)}{(x-2)(x-3)}$ and $\frac{y^2}{a^2} = \frac{x(x-1)}{(x-2)(x-3)}$.

13. A Norman window consists of a rectangle surmounted by a semicircle. Having given the periphery, determine the height and breadth of the window when the quantity of light admitted is the greatest possible.

14. Find the equation to the curve in which a chain acted on by gravity will hang.

V.

1. Give Euclid's constructions for inscribing a circle in a given triangle, and describing a circle about a given triangle. If R, r be the radii of the circumscribed and inscribed circles of a triangle, the square of the distance between the centres $= R^2 - 2Rr$.

2. Similar triangles are to one another in the duplicate ratio of their homologous sides.

3. A clock is right at mid-day to-day, but it gains one minute per day. What will be the true time when it points to mid-day to-morrow?

4. Divide ·01 by ·0002 and ·00001 by ·03; find also a fourth proportional to ·999, 33·3 and ·03.

5. Solve the equations:

$$(1)\ x + y = 4,\ x^4 + y^4 = 82; \qquad (2)\ \cos\theta + \sin\theta = + \frac{1}{\sqrt{(2)}}.$$

and shew that if $ax^2 + bx + c = 0$ and $a_1x^2 + b_1x + c_1 = 0$, then will

$$(ab_1 - a_1b)(bc_1 - b_1c) = (ac_1 - a_1c)^2.$$

6. There are n things of which p are alike and the remaining $n - p$ different. Shew how to find the number of permutations of them taken r together. Ex. $n = 7, p = 3, r = 3$.

7. Find by the Binomial Theorem the coefficient of x^r in the expansion of $(1 - x)^{-\frac{1}{2}}$ and $\dfrac{(1 - 2x)^2}{(1 - x)^4}$;

and find when the series for $(1 + \frac{1\cdot 1}{1\cdot 2})^{-3}$ begins to converge.

8. The probability of A solving a problem is $\frac{1}{4}$, and of its being solved when both A and B try it is $\frac{3}{4}$. Find the probability of B solving it.

9. A person walking along a straight road observes the greatest angle α subtended by two objects in the same plane with the road. He then walks a distance a along the road, and the objects appear in the same direction making an angle β with the road. Shew that the mutual distance of the objects

$$= \frac{2a \sin\alpha \sin\beta}{\cos\alpha + \cos\beta}.$$

10. Define a rectilinear asymptote. Prove the property of the hyperbola $RP.Pr = CB^2$, and shew hence that the lines CR, Cr are asymptotes.

11. If $y = e^{-x} \cos x$, shew that $\dfrac{d^4y}{dx^4} + 4y = 0$, and find the value of $\dfrac{1}{\log x} - \dfrac{x}{\log x}$ when $x = 1$.

12. Explain the action of an oar in rowing. If a man pulls an oar 12 feet long with a force of 120 lbs., the distance from the handle to the rowlock being 3 feet, what is the effective force to propel the boat?

13. Define the centre of gravity of a body. Mention how it is shewn that every body has a centre of gravity.

Eight equal bodies are placed at the angular points of a cube. If one be taken away, where will the centre of gravity of the remainder be?

14. Two bodies are projected vertically upwards from the same point with equal velocities u at an interval of one second. When and where will they meet?

MINOR SCHOLARSHIP EXAMINATION.

ST. JOHN'S COLLEGE. *June*, 1861.

I.

Translate:

1. *From* Τάχα δ' ἂν ἴσως,....
   to ....καὶ πρὶν ἐπιχειρῆσαι ἔσται.
   THUCYD. VI., 10.
2. *From* Καὶ τάδε ἄλλα Αἰγυπτίοισί....
   to ....κατὰ τὠυτὸ νομίζουσι ἀποβήσεσθαι.
   HEROD. II., 82.
3. *From* Αἰσχρὸς ὦ ἄνδρες Ἀθηναῖοι....
   to ....μηδαμῶς, ὦ ἄνδρες Ἀθηναῖοι.
   DEMOSTH., *C. Leptin.*, p. 505, Reiske.

Translate into Greek Prose:

The historian to whom we are indebted for the most ample and authentic information we possess concerning Alexander, Arrian of Nicomedia, takes this occasion to remark, that in this respect the Macedonian hero had indeed been singularly unfortunate; since even the expedition of the younger Cyrus, and the return of the ten thousand, had been rendered by Xenophon's pen more renowned than the incomparably greater actions which he himself was about to record. The remark itself strikes us as somewhat strange, when we reflect on the immense mass of historical writings, which in Arrian's time were still extant, relating to Alexander's reign, and that among the contemporary authors who treated this subject, two were eminently qualified by their station and opportunities to do it justice. Two of his generals, Aristobulus, and Ptolemy, who held one of the highest posts in the army, and afterwards became king of Egypt, undertook the office of relating his conquests; and they both wrote after his death, when they were no longer subject to the strongest of the motives that might before have induced them to swerve from the truth.

II.

Translate the following passages into English Prose:

1. *From* ὦ θεώμενοι, κατερῶ πρὸς ὑμᾶς....
to .... ἥνπερ ἴδῃ, τἀδελφοῦ τὸν βόστρυχον.
Aristoph., *Nub.*, 503—521.

2. *From* ..ὁ δ', ὡς ἐσεῖδε, δώματ' αἴθεσθαι δοκῶν,....
to ....ἀσκεῖν σώφρον' εὐοργησίαν.
Eurip., *Bacch.*, 610—636.

3. *From* XO. Πέπονθας αἰκὲς πῆμ',....
to ....ἐξαμύνωνται νόσους.
Æsch., *Prom. Vinct.*, 472—483.

4. *From* 'Εντὶ δάφναι τηνεὶ,...
to ....ἐρυθρὰ πλαταγώνι' ἔχοισαν.
Theocr., *Id.*, xi., 45—56.

Translate into Greek Tragic Iambics:

He comes, and with a port so proud,
As if he had subdu'd the spacious world:
And all Sinope's streets are fill'd with such
A glut of people, you would think some God
Had conquer'd in their cause, and them thus rank'd,
That he might make his entrance on their heads!
While from the scaffolds, windows, tops of houses,
Are cast such gaudy show'rs of garlands down
That ev'n the crowd appear like conquerors,
And the whole city seems like one vast meadow,
Set all with flow'rs as a clear heav'n with stars.

Lee.

III.

Translate into English Prose:

1. *From* Videte, judices, quantæ res his....
to ....denique ei nuntiabatur?
Cic. *pro Mil.* c. 18.

2. *From* Inclinatis semel in concordiam....
to ....vis ingens æris alieni sit.
Liv. vii. 21.

3. *From* Sed ubi diem ex die prolatabant....
to ....an bellum cunctatione tractaret.
Tac. *Ann.* vi. 42-44.

Translate into Latin Prose:

Nor let any one suppose that this conflict of evidence renders the attainment of certainty impossible. Doubtless there are many points both in sacred and in common history, both in civil and ecclesiastical records, where we must be content to remain in suspense. History will have left half its work undone, if it does not teach us humility and caution. But essential truth can almost always be found: truth of all kinds can with due research be usually found: she lies, no doubt, in a well; but we may be sure that she is there if we dig deep enough. In this labour teachers and students must all work together. What one cannot discover, many at work on the same point can often prove beyond doubt. Like Napoleon and his comrades, when lost in the quicksands of the Red Sea, let each ride out a different way, and the first that comes to firm ground bid the others halt and follow him.

IV.

Translate:

From A. Adeon' rem redisse, ut qui mihi....
to ....animus qui modeste istæc ferat.

TER. PHORM. I. 3.

From Desine, Paulle, meum lacrimis. ..
to ....In mea sortita vindicet ossa pila.

PROPER. V. 11.

From Ardet, inexcita, Ausonia,....
to ....fidoque accingitur ense.

VIRG. *Æn*. VII. 623.

Translate into Latin Elegiacs:

In dark Thermopylæ they lie;
Oh death of glory there to die!
Their tomb an altar is, their name
A mighty heritage of fame:
Their dirge is triumph—cankering rust,
And time that turneth all to dust,
That tomb shall never waste nor hide,
The tomb of warriors true and tried,
The full-voiced praise of Greece around
Lies buried in that sacred mound,
Where Sparta's king Leonidas,
In death eternal glory has.

From the Greek Anthology.

V.

1. The opposite sides and angles of parallelograms are equal to one another, and the diameter bisects them.

If the diagonals of a quadrilateral figure bisect each other, it must be a parallelogram.

2. The opposite angles of a quadrilateral figure inscribed in a circle are together equal to two right angles.

The opposite sides of a quadrilateral inscribed in a circle are produced to meet in P and Q, and about the triangles so formed without the quadrilateral circles are described meeting again in R; shew that P, R, Q are in one straight line.

3. If the angle of a triangle be divided into two equal angles by a straight line which also cuts the base, the segments of the base shall have the same ratio which the other sides of the triangle have to one another; and conversely.

Given the base of a triangle and the point where the line bisecting the exterior vertical angle cuts the base produced, find the locus of the vertex of the triangle.

4. Find the locus of a point without a square such that straight lines being drawn from it to the angular points of the square, the angle contained by the two extreme lines is divided into three equal parts by the other two.

5. Shew how to reduce any recurring decimal to its equivalent vulgar fraction. Divide $1\cdot1\dot{3}$ by $\cdot00\dot{0}13\dot{2}$.

6. What is the half-yearly interest obtained if £385. 7*s.* $3\frac{1}{2}$*d.* be invested in the purchase of 3 per cent. stock at $91\frac{3}{8}$?

7. The carpeting of a room twice as long as it is broad at 5 shillings per square yard, cost £6. 2*s.* 6*d.*; and the painting of the walls at 9 pence per square yard, cost £1. 6*s.* 3*d.* What is the height of the room?

8. What sum of money will amount to £425. 19*s.* $4\frac{4}{5}$*d.* in 10 years at $3\frac{1}{2}$ per cent. simple interest; and in how many years more will it amount to £453. 11*s.* 7*d.*?

9. Reduce the following expressions to a single fraction;

$$\frac{a^2}{(x-a)(a-b)(a-c)}+\frac{b^2}{(x-b)(b-a)(b-c)}+\frac{c^2}{(x-c)(c-a)(c-b)}.$$

10. Solve the following equations:

$$(1)\quad \frac{x+a}{x+b}=\left(\frac{2x+a+c}{2x+b+c}\right)^2,\qquad (2)\quad \frac{1}{x+a+b}=\frac{1}{x}+\frac{1}{a}+\frac{1}{b},$$

$$(3)\quad x^4-x^2+y^4-y^2=84,\quad x^2+x^2y^2+y^2=49.$$

11. Explain what is meant by *Mathematical Induction.* Shew by it that the sum of the cubes of the first n natural numbers is equal to the square of the sum of the numbers.

12. A person has a capital of £2000, which produces him interest at 5 per cent.; if he spend every year £180, find in how many years he will be ruined; having given

$$\log 2 = \cdot 30103, \quad \log 3 = \cdot 47712, \quad \log 7 = \cdot 84510.$$

13. Shew that the arithmetical mean of any number of positive quantities is greater than the geometrical mean.

Shew that $(a+b+c+d)(a^3+b^3+c^3+d^3) > 16abcd$.

VI.

1. Define the cosine of an angle;—express the cosine in terms of each of the other Trigonometrical Ratios.

2. Find a formula which shall include all angles which have the same co-tangent—and write down the four smallest angles which satisfy the equation $3\cot^2\theta - 1 = 0$.

3. Prove that

i. $\tan(A-B) = \dfrac{\tan A - \tan B}{1+\tan A \tan B}$, geometrically or otherwise.

ii. $\cos^2 A + \cos^2 B + \cos^2 C + 2\cos A \cos B \cos C = 1$, if $A+B+C = 180^\circ$.

4. Find the value of x in each of the equations:

i. $\tan^{-1}(x-1) + \tan^{-1}(x+1) = \frac{1}{6}\pi$, ii. $\tan x + \tan 3x = 2\tan 2x$.

5. Find the numerical value of $\sqrt[14]{(242447)}$,

having given $\log_{10} 24244 = 4\cdot 3846043$, diff. for $1 = 179$.

6. Shew that the base of the Napierian logarithms is incommensurable.

Prove that $\left\{1 + \dfrac{1}{\underline{|2}} + \dfrac{1}{\underline{|4}} + \ldots\right\}^2 = 1 + \left\{1 + \dfrac{1}{\underline{|3}} + \dfrac{1}{\underline{|5}} + \ldots\right\}^2$.

Also if $\sin\{\theta + \phi\sqrt{(-1)}\} = \rho\{\cos a + \sqrt{(-1)}\sin a\}$ where ρ, a, θ, ϕ are real quantities, then will

$$\tan a = \frac{e^{\phi} - e^{-\phi}}{e\phi + e^{-\phi}}\cot\theta \text{ and } 4\rho^2 = e^{2\phi} + e^{-2\phi} - 2\cos 2\theta.$$

7. What is meant by the *parameter* of any diameter of a parabola? Prove, with the usual notation, that $QV^2 = 4SP.PV$.

8. In an ellipse prove that $CP^2 + CD^2 = AC^2 + BC^2$.

Also if the normal at P meet the axis-major in G and the conjugate diameter in F, then $PF.PG = BC^2$.

9. A circle is described upon the latus rectum of a parabola as a diameter, and any chord QPN is drawn parallel to the axis of the parabola,—meeting the circle in Q, the parabola in P, and the latus rectum in N, prove that $QN^2 \propto PN$.

10. Find the equation to the tangent to an ellipse

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

under the form $y = mx + \sqrt{(m^2a^2 + b^2)}$.

Deduce the corresponding equation to the tangent to a parabola $y^2 = 4cx$.

11. If $y = mx$, $y = m'x$ be conjugate diameters of the curve $ax^2 + 2bxy + cy^2 = f$, m and m' must be connected by the relation $a + (m + m')\,b + mm'c = 0$.

12. What is meant by the moment of a force with respect to a point? The algebraic sum of the moments of two forces acting in one plane about any point in the plane is equal to the moment of their resultant.

13. Explain how the statical action of a hinge or pivot may be estimated.

A plane lamina which can turn about a pivot P is acted on by two equal forces (Q, Q) in opposite directions at a distance c from each other—find the least force which can be applied at a given point A so as to maintain equilibrium—and the pressure on the pivot.

14. Shew that the path of a projectile is a parabola—and that at every point of the path the velocity is that which would be acquired by a body falling to that point from the directrix.

Particles are projected from the same point and in the same vertical plane so as to describe equal parabolas—shew that the vertices of their paths lie in a parabola.

VII.

1. Find the equation to the straight line which passes through the intersection of the lines

$$\frac{x}{a} + \frac{y}{b} = 1, \quad \frac{x}{a'} + \frac{y}{b'} = 1,$$

and also through the intersection of the lines

$$\frac{x}{a'} + \frac{y}{b} = 1, \quad \frac{x}{a} + \frac{y}{b'} = 1.$$

2. Find the polar equation to a parabola when the vertex is the pole, and the axis of the parabola the initial line. Determine the shortest chord which can be drawn in a parabola so as to subtend a right angle at the vertex.

3. Find a point in an ellipse such that the normal at the point bisects the angle between the ordinate of the point and the central radius vector of the point.

4. P is any point on the perimeter of an ellipse, S a focus, M a fixed point in the major axis; a perpendicular is drawn from M on the tangent at P; find the locus of the intersection of this perpendicular with the radius vector SP.

5. Shew that the area of the parallelogram formed by normals at the extremities of conjugate diameters of an ellipse is $\frac{(a^2 - b^2)^2}{ab} \sin^3 2\phi$, where ϕ is the *excentric angle* of one of the extremities.

6. Expand $\log(1 - x + x^2)$ by Maclaurin's Theorem in powers of x as far as the term involving x^4.

7. Two ships are sailing with uniform velocities u and v along two straight lines inclined at a given angle; if a and b are the distances of the ships at starting from the point of intersection of their courses, find the least distance of the ships.

8. Find the evolute of an ellipse assuming that the equation to the normal to an ellipse can be put in the form

$$ax \sec\phi - by \operatorname{cosec}\phi = a^2 - b^2.$$

9. Trace the curve $y^3 = (x - a)^2 (x - c)$; supposing a greater than c.

10. Find the limit when n is infinite of

$$\frac{a}{n} \left\{ \sin \frac{a}{n} + \sin \frac{2a}{n} + \sin \frac{3a}{n} + \ldots + \sin \frac{n-1}{n} a \right\}.$$

SCHOLARSHIP EXAMINATION.

MAGDALENE COLLEGE. *January*, 1861.

I.

Translate into English Prose:

From Καὶ ἐγὼ μὲν, ἅπερ καὶ ἀρχόμενος εἶπον,....
to ....ὑπὸ ἄλλων ἧσσον ἐπιβουλευομένην.

THUC., *Lib.* IV., 64.

From ΣΩ. Φέρε δή, πῶς αὖ τὰ τοιαῦτα ἐλέγετο;....
to ....ΚΡ. Οἶμαι ἔγωγε, ὦ Σώκρατες.

PLAT., *Crit.*, cap. VII.

From Ὣς ἔφαθ'· αἱ δ' ἀπάνευθεν ἴσαν,....
to ....τοὶ οὐρανὸν εὐρὺν ἔχουσιν.

HOM., *Odys.*, Lib. VI., 223 –243.

From OI. κάθιζέ νύν με, καὶ φύλασσε....
to ....ἔχείς γὰρ χῶρον οὐχ ἁγνὸν πατεῖν.
Soph., *Œd. Col.*, 22—37.

Into Latin Alcaics:
From ἔρωτες ὑπὲρ μὲν ἄγαν....
to ....δώρημα κάλλιστον θεῶν.
Eur., *Medea*, 627—636.

II.

Translate into Greek Prose:

The Czar's army now began to be in want of provisions, nor could without the greatest difficulty procure water, though encamped at a very small distance from the river, owing to the works erected along the river which were manned by large masses of troops. By this account, which is perfectly circumstantial and true, it appears that the Turkish general, far from being the pusillanimous or weak commander which his adversaries represented him to be, gave proofs on this occasion that he perfectly well understood his business. The passing of the river in sight of the enemy; the obliging him to retreat, and harassing him in that retreat; the intercepting a body of cavalry that was marching to reinforce the army, and the cutting off all supplies and provisions, were manœuvres that in no way bespoke an inexperienced or indolent general.

Life of Peter the Great.

Translate into Greek Iambics:

Shall I compare thee to a summer's day?
Thou art more lovely and more temperate:
Rough winds do shake the darling buds of May,
And summer's lease hath all too short a date:
Sometimes too hot the eye of heaven shines,
And often is his gold complexion dimmed;
And every fair from fair sometimes declines
By chance or nature's changing course untrimmed:
But thy eternal summer shall not fade,
Nor shall Death brag thou wander'st in his shade,
So long as men can breathe, or eyes can see,
So long lives this, and this gives life to thee.

Shakespeare, *Sonnets*, xviii.

III.

Translate with brief Notes, into English:

From Cœlo supinas si tuleris manus....
to ....Fane pio et saliente mica.
Hor. *Od.* III. 23.

From Tertia lux, memini, ludis erat....
to ....magnificas quercus habebat opes.
Ovid, *Fasti.* IV. 377—400.

From A. Postumius et L. Julius, non justo delectu,....
to ....instauratu, ut assolet, facito.
Livy, v. 16.

From Nerone secundum, L. Pisone consulibus,....
to ....conjugis cognovit, et insontem nuntiavit.
Tac. *Ann.* XIII. 31, 32.

IV.

Translate into Latin Hexameters:

All night the dreadless angel, unpursued,
Through heaven's wide champaign held his way, till morn,
Waked by the circling hours, with rosy hand
Unbarr'd the gates of light. There is a cave
Within the mount of God, fast by his throne,
Where light and darkness in perpetual round
Lodge and dislodge by turns, which makes through heaven
Grateful vicissitude, like day and night:
Light issues forth, and at the other door
Obsequious darkness enters, till her hour
To veil the heaven, though darkness there might well
Seem twilight here: and now went forth the morn
Such as in highest heaven array'd in gold
Empyreal; from before her vanish'd night,
Shot through with orient beams —.

Milton, *Paradise Lost*, Book VI.

Into Latin Prose:

Indeed all ranks of men were so corrupted that tables were publicly set out, upon which the candidates for offices were professedly ready to pay the people the price of their votes; and the people came not only to give their voices for the man who had bought them, but with all manner of offensive weapons to fight for him. Hence it often happened that they did not part without polluting the tribunal with blood and murder, and the city was a perpetual scene of anarchy. In this dismal state of things, in these storms of epidemic madness, wise men thought it would be happy if they ended in nothing worse than monarchy ; nay, there were many who scrupled not to declare publicly, that monarchy was the only cure for the desperate disorders of the state.

V.

1. If two triangles have two sides of the one equal to two sides of the other, each to each; and have likewise the angles contained by those sides equal to one another; they shall likewise have their bases, or third sides, equal; and the two triangles shall be equal; and their other angles shall be equal, each to each, viz. those to which the equal sides are opposite.

If in the sides of an equilateral triangle *ABC*, equal spaces *Aa*, *Bb*, *Cc* be taken, and the points *a*, *b*, *c* be joined; shew that *abc* is also an equilateral triangle.

2. If, at a point in a straight line, two other straight lines, upon the opposite sides of it, make the adjacent angles together equal to two right angles, these two straight lines shall be in one and the same straight line.

In the figure of Euclid I. 49, *A* being the right angle of the given triangle, and *F* and *K* the corners of the squares on *AC*, *AB*, furthest removed from point *A*; shew that *F*, *A*, *K*, are in one straight line.

3. The straight lines which join the extremities of two equal and parallel straight lines towards the same parts, are also themselves equal and parallel.

The angles *A* and *C* of a parallelogram *ABCD* are trisected and the angles *B* and *D* are bisected. The bisector of *D* meets the lines trisecting *A* in *a*, *b*; and the bisector of *B* meets the lines trisecting *C* in *c*, *d*. Shew that *abcd* is a parallelogram of which two sides are parallel to two sides of *ABCD*.

4. In a circle, the angle in a semicircle is a right angle; but the angle in a segment greater than a semicircle is less than a right angle; and the angle in a segment less than a semicircle is greater than a right angle.

The circumferences of three unequal circles, whose centres are *A*, *B*, *C*, pass through a common point *O*, from which lines are drawn through *A*, *B* and *C*, meeting the circumferences in A', B', C'. Shew that the sides of triangle $A'B'C'$ pass through the other points of intersection of the circles, and are respectively parallel to the sides of the triangle formed by joining the points A, B, C.

5. In a right-angled triangle, if a perpendicular be drawn from the right angle to the base; the triangles on each side of it are similar to the whole triangle, and to one another.

AB any arc of a circle is bisected in D, and a perpendicular to the diameter AC is drawn meeting the chord AB in E. Shew that if DC be joined meeting the chord AB in F, then AE is equal to EF.

6. If a solid angle be contained by three plane angles, any two of them are greater than the third.

7. Distinguish between the geometrical and trigonometrical definition of an angle.

What are the several units made use of in the measurement of angles?

Shew that the unit of circular measure is a constant quantity whatever be the radius of the circle assumed.

If instead of an arc equal to the radius of the circle, the circumference were taken; what would the angle, the ordinary circular measure of which is θ, become?

8. Define the sine, cosine, and tangent of an angle, and determine their values when the angle is 30°, 45°, and 60°.

If $\operatorname{cosec} A + \cot A = \sqrt{(3)}$; find A.

9. Find an expression for $\sin A$ in terms of $\sin 2A$; and shew that, à priori, such an expression must admit of four different values when A is arbitrary.

10. If α, β, γ, be the lengths of the lines joining the feet of perpendiculars from the angles of a triangle on the opposite sides, shew that

$$\frac{\alpha}{a^2} + \frac{\beta}{b^2} + \frac{\gamma}{c^2} = \frac{a^2 + b^2 + c^2}{2abc},$$

where a, b, c, are the lengths of the sides respectively opposite to the lines α, β, γ.

11. The perpendicular from one of the equal angles of an isosceles triangle upon the opposite side is $\dfrac{c\sqrt{(4a^2 - c^2)}}{2a}$, where c denotes the base and a is the length of each of the equal sides.

12. Investigate expressions for $\sin\theta$ and $\cos\theta$ in terms of θ. Hence shew that $\theta = \tan\theta - \frac{1}{3}\tan^3\theta + \frac{1}{5}\tan^5\theta - \&c.$, and explain the use of the formula.

What is the unit of angular measurement employed? Where was it introduced, and why?

V.

1. Diophantus says:

> λεῖψις ἐπὶ λεῖψιν πολλαπλασιασθεῖσα ποιεῖ ὕπαρξιν· λεῖψις δὲ ἐπὶ ὕπαρξιν ποιεῖ λεῖψιν.

Prove the truth of these two propositions.

2. Among how many men must £105. 8*s*. 4*d*. be divided in order that each man may have £10. 10*s*. 10*d*.?

3. Distinguish between Interest and Discount.

If the discount on eleven hundred pounds, which is due at the end of two years and a-half, is a hundred pounds, what is the rate per cent. at simple interest?

4. Represent the sum of the fractions

$$\frac{1}{x(x-y)(x-z)}, \quad \frac{1}{y(y-z)(y-x)}, \quad \frac{1}{z(z-x)(z-y)},$$

in its most simple form.

5. Describe the rule for finding the highest common divisor of two algebraical polynomials.

Find that of the two expressions

$$x^3-(2a+b)x^2+a(2a+b)x-a^2(a+b), \quad x^3-(2b+a)x^2+b(2b+a)x-b^2(b+a).$$

6. "Out of a heap of pure lotus flowers, a third part, a fifth, and a sixth, were offered respectively to the gods Siva, Vishnu, and the Sun; and a quarter was presented to Bhavani. The remaining six lotuses were given to the venerable Preceptor. Tell quickly the whole number of flowers."

7. What are the values of x, y, z, as determined by the simultaneous equations

$$\frac{1}{y}+\frac{1}{z}=\frac{1}{b}+\frac{1}{c}, \quad \frac{1}{z}+\frac{1}{x}=\frac{1}{c}+\frac{1}{a}, \quad \frac{1}{x}+\frac{1}{y}=\frac{1}{a}+\frac{1}{b}?$$

8. Find the expression for the sum of an arithmetical progression of which the first term, the common difference, and the number of terms, are given.

If the common difference is equal to twice the first term, prove that the quotient of the sum divided by the first term is a perfect square.

9. If the recurring quantity $.\,a_1 a_2 a_3 \ldots a_n \ldots\ldots$, where $a_1, a_2, a_3, \ldots, a_n$, are the digits of the repeating period, in a scale of notation of which the radix is r, is integral; prove that each of these digits is equal to $r-1$.

10. State the principle of indeterminate coefficients, and apply it to find the values of λ, μ, ν, supposing that, for all values of x,

$$\frac{1}{(x-1)(x-2)(x-3)}=\frac{\lambda}{x-1}+\frac{\mu}{x-2}+\frac{\nu}{x-3}.$$

11. Having given the equations
$x + y + z = 0$, $x' + y' + z' = 0$, $a^2 = x^2 + x'^2$, $b^2 = y^2 + y'^2$, $c^2 = z^2 + z'^2$; prove that $a^2 (yz - y'z') + b^2 (zx - z'x') + c^2 (xy - x'y') = 0$.

12. Prove that the values of the two recurring fractions

$$2 + \frac{1}{2+}\,\frac{1}{2+}\ldots, \text{ and } \frac{1}{-2+}\,\frac{1}{-2+}\,\frac{1}{-2+}\ldots,$$

are roots of the quadratic equation $x^2 - 2x = 1$.

13. Prove that $\log_e x = (x - 1) - \frac{1}{2}(x - 1)^2 + \frac{1}{3}(x - 1)^3 \ldots$, and shew that $\log_e 101 - \log_e 99 = \frac{1}{50}$, very nearly.

14. The Prince of I and Sankolinsin agree in a statement: supposing that, in making assertions, the Prince is in the habit of speaking falsely four times out of five, and that Sankolinsin ordinarily tells the truth twice in seven times, what are the odds against the truth of the concurrent testimony of the Prince of I and Sankolinsin?

OPEN SCHOLARSHIPS.

ST. CATHARINE'S COLLEGE. *June*, 1861.

I.

Translate the following passages:

1. *From* Ἄνδρες οἱ ξυναράμενοι τοῦδε....
to ....σώζειν ὑμᾶς τε αὐτοὺς καὶ τὸ χωρίον.
THUCYDIDES.

2. *From* ὦ χαῖρε, πρέσβυ, φίλτατ’....
to ....Ζεὺς δ’ ἐπέκρανεν τέλος.
ÆSCHYLUS.

Translate into Greek Prose:

When the Athenians returned to their country they found a wasted land, and a city which, with the exception of a few houses that had been occupied by the principal Persians, was a heap of ruins. The public coffers were drained by the war, and though the spoil may have enriched some individuals, that part of it which fell to the share of the State was mostly consecrated to the gods. Thus Athens might seem to be reduced to the lowest stage of poverty and weakness. But in reality her strength had never before been so great, and time only was wanting first to call it into action, and then to clothe it with beauty and splendour.

THIRLWALL.

Translate into Greek Iambics:

I ask thee not to approve thy husband's death,
No, nor expect thee to admit the grounds,
In reason good, which justified my deed:
With women the heart argues, not the mind.
But for thy children's death I stand assoil'd;
I sav'd them, meant them honour, but thy friends
Rose, and with fire and sword assail'd my house
By night; in that blind tumult they were slain.
To Chance impute their death, then, not to me.

MATTHEW ARNOLD.

II.

Translate the following passages:

1. *From* Omnia sunt misera in bellis civilibus....
to ....et vitæ et fortunis tuis. Vale.

CICERO.

2. *From* Atque ubi jam patriæ perventum....
to ....mortemque miserrimus opto.

VIRGIL.

Translate into Latin Prose:

What an unfortunate task it would be, for a charioteer who had harnessed a set of horses, however strong, if he could not make them draw together; if while one of them would go forward, another was restiff, another struggled backward, another started aside. If even one of the four were unmanageably perverse, while the three were tractable, an aged beggar with his crutch might leave Phaëton behind. So in a human being, unless the chief forces act consentaneously, there can be no inflexible vigour, either of will or execution. *One* dissentient principle in the mind not only deducts so much from the strength, and mass of its agency, but counteracts, and embarrasses all the rest.

FOSTER.

Translate into Latin Elegiacs:

Ye winds that have made me your sport,
Convey to this desolate shore,
Some cordial endearing report
Of a land I shall visit no more.
My friends do they now and then send
A wish or a thought after me?
Oh! tell me I yet have a friend,
Though a friend I am never to see.

How fleet is the glance of the mind!
Compared with the speed of its flight,
The tempest itself lags behind,
And the swift-winged arrows of light.
When I think of my own native land,
In a moment I seem to be there;
But alas! recollection at hand
Soon carries me back to despair.

COWPER.

III.—ARITHMETIC AND EUCLID.

1. A gentleman at a flower-show took off his hat to ladies 20 times. In 7 cases there were two ladies of his acquaintance together; in 2 cases there were three together; and to one lady he bowed twice. In all other cases he made a bow to each. How many ladies whom he knew did he meet at the show?

2 A, B, C are three stations on a Railway. An express train goes from A to C in the same time that a mail train takes to go from A to B, and that a parliamentary train takes to go from B to C. If the pace of a parliamentary is $\frac{2}{3}$ that of a mail train, compare the rates of an express and a mail train.

3. ....

4. Write down the number of square yards in an acre, of linear yards in a mile, and of ounces in a hundred-weight.

5. A man goes out with £3. 5*s.* 4*d.* in his pocket. He spends $\frac{3}{7}$ of it at one shop, and $\frac{3}{8}$ at another. To how many poor people can he give $5\frac{1}{2}$*d.* each with the remainder?

6. Divide 220·8864 by 72·66, and 2·208864 by ·07266.

7. Define a *plane superficies*, a *rhombus*, a *circle*, *parallel straight lines.*

8. If the equal sides of an isosceles triangle be produced, the angles upon the other side of the base shall be equal.

9. Parallelograms upon equal bases and between the same parallels are equal to one another.

A parallelogram has one side fixed, while the other sides move in such a manner that its area is always the same. In what line will the intersection of its diagonals move?

10. In any right-angled triangle, the square which is described on the side subtending the right angle is equal to the squares described on the sides which contain the right angle.

If a man's head were a sphere of 10 inches diameter, and his brain were enclosed in a concentric sphere of 8 inches diameter, find the greatest length inside his scull which a bullet might traverse without killing him.

11. If a straight line be divided into two equal and also into two unequal parts; the squares of the two unequal parts are together double of the squares of half the line and of the square of the line between the points of section.

Shew that 3 times the sum of the squares of the sides of any triangle = 4 times the sum of the squares of the lines joining the angular points with the middle points of the opposite sides.

12. The opposite angles of a quadrilateral inscribed in a circle are together equal to two right angles.

A segment of a circle rolls upon a plane from one end of its circumference to the other. Shew that the angle through which the base of the segment revolves together with twice the angle in the segment equals four right angles.

13. If from any point without a circle two straight lines be drawn, one of which cuts the circle and the other touches it; the rectangle contained by the whole line which cuts the circle and the part of it without the circle, shall be equal to the square of the line which touches it.

A circle of known radius moves so as to cut a fixed circle in two points which always lie in the same straight line with a given point. Shew that the centre of the former circle moves along an arc of a circle whose centre is the given point; and find by construction the length of that arc.

14. Parallelograms about the diameter of any parallelogram are similar to the whole and to one another.

15 How is the angle between two intersecting planes measured? State the properties of a solid angle given by Euclid in Book XI.

IV.—ALGEBRA AND TRIGONOMETRY.

1. What is the meaning of the expression $a \times b$ where a and b are whole numbers? Shew that its value is the same as that of $b \times a$.

2. What is meant by the Greatest Common Measure of two algebraical quantities? Find that of

$$4x^5 - 6x^4 - 6x^2 + 4x - 6 + 4x^3 \text{ and } 8x^4 - 4x^3 - 28x^2 + 24x.$$

3. Prove the rule for the division of a fraction by a whole number, and simplify the following expression

$$\frac{\dfrac{1}{x^4 + x^2y^2 + y^4}}{\dfrac{1}{x^3 + y^3}\cdot(x + y)} \cdot \frac{x^3 - y^3}{x - y}.$$

4. Assuming that $a^m \times a^n = a^{m+n}$ for all values of m and n, *investigate* a meaning for $a^{\frac{p}{q}}$, $\frac{p}{q}$ being a proper fraction.

Assuming a meaning for such an expression as $a^{\frac{p}{q}}$, *prove* that

$$a^{\frac{p}{q}} \times a^{\frac{r}{s}} = a^{\frac{p}{q}+\frac{r}{s}}.$$

5. Investigate a rule for finding the cube root of an algebraical expression, and find that of

$$8x^6 - 36x^5 + 66x^4 - 63x^3 + 33x^2 - 9x + 1.$$

6. Solve the equations

(1) $x^3 - 2x^2 + 2x - 1 = 0.$ (2) $6x^2 + 6y^2 = 13xy,\ x^3 + y^3 = 35.$

7. Shew how to find the sum of a series of quantities in Geometrical Progression, explaining what is meant by the limit of an infinite series, and in what case such a limit exists.

Sum the series $2 + 5x + 8x^2 + 11x^3 + \ldots$ to n terms and, when possible, to infinity.

8. Find the greatest term in the expansion of $(1 + x)^n$, n being a negative quantity.

Ex. $\left(\frac{2x}{5} - \frac{x^2}{3}\right)^{-\frac{3}{x}}$ when $x = \frac{1}{10}$.

9. What is meant by a unit of measurement? What are the three different units usually employed in measuring angles? Shew how to pass from one system of measurement to another.

10. What are the Trigonometrical Ratios? What is the advantage of using them?

Shew that $\cos(180° - A) = -\cos A$ and trace the changes in sign and magnitude of $\cos A$ as A increases from 0° to 270°.

11. Having given two sides of a triangle and the included angle, shew how, without determining the remaining angles, to

find the remaining side in a form adapted to logarithmic computation, and explain fully the nature and use of *subsidiary angles*.

12. Find the sum of a series of cosines of angles in arithmetical progression, and if $\phi = \frac{\pi}{13}$,

shew that $\cos\phi + \cos 3\phi + \cos 5\phi + \ldots + \cos 11\phi = \frac{1}{2}$.

13. Find expressions for $\cos\alpha$ and $\sin\alpha$ in terms of α. At what point of the proof is the necessity of α being *circular measure* introduced?

MINOR SCHOLARSHIPS.

CLARE COLLEGE. *May*, 1861.

I.

Translate:

From Εἰ μὲν οὖν ἤκουσεν, οἶμαι,....
to ....οὐδαμῇ προΐεντο ἑαυτούς.
DEMOSTH., περὶ τῆς παραπρεσβείας.

From ΚΡ. τί δῆτ' ἀφαυρῷ φωτὶ....
to ....ἡμᾶς ἐνδίκου προμηθίας.
SOPH. *Œd. Col.*, 1018—1043.

From Sic omnes amor unus habet....
to ....clauduntur lumina noctem.
VIRG., *Æn.*, XII., 281—310.

II.

I. Translate, and explain the allusions in

1. *From* Vitanda tamen suspicio est avaritiæ....
to ....in præclara illa propylæa conjecerit.
CICERO, *De Officiis.*

2. *From* Responsum est a concione, mandata....
to ....præmia sub dominis, pœnas sine arbitro esse?
TACITUS, *Annals.*

II. Translate into Latin Prose:

From But why, the question then arose, must money be only of gold and silver?....

to ....inasmuch as if after they would reform the same fault, it would ask time before credit be won again.

III.

1. Give the names of the various books of the Old Testament in their chronological order.

2. Why was Moses excluded from the promised land? State the circumstances of his death.

3. Who were the Rechabites?

4. Give some account of David's children, marking the fortunes and end of each.

5. "Make them and their princes like Oreb and Zeb: yea, make all their princes like as Zeba and Salmana," Ps. lxxxiii., 11. Give the history to which the passage refers.

6. "Mine own familiar friend whom I trusted," Ps. xli., 9. Of whom was this primarily spoken, and to whom did it prophetically apply? Draw a parallel between the two cases.

7. Give instances, both from the Old and New Testaments, of the use of forms of public worship. Mention the advantages attending the use of forms of prayer in general.

8. What are the proper lessons for Trinity Sunday? Wherein consists their special fitness for the occasion?

9. How would you deduce the opinion of the English Church as to the observance of the Sabbath? What does the prophet Isaiah say as to the manner in which the Sabbath should be observed, and the blessing attending such observance?

10. What is the authority for Infant Baptism?

11. "Whereof is one Christ, very God, and very Man; who truly suffered, was crucified, dead and buried, *to reconcile his Father to us*, and to be a sacrifice, not only for original guilt, but also for all actual sins of men." Art. II. What passages of Scripture are commonly adduced in support of the words in italics?

12. Under what circumstances is a special confession of sin to the minister recommended by the English Church (1) in health, (2) in sickness? What objections are there to a frequent use of this kind of confession?

IV.—EUCLID AND TRIGONOMETRY.

1. At a given point in a given straight line make an angle equal to a given rectilineal angle.

Having given an angle, make another $3\frac{1}{2}$ times as great. Is it possible to make one $2\frac{1}{3}$ times as great.

2. Define parallel straight lines. Give also the 12th axiom, and state your opinion whether it might be advantageously superseded by any other, with your reasons for the same.

3. Triangles upon the same base, and between the same parallels are equal to one another.

The line joining the bisections of two sides of a triangle is parallel to the base.

The lines joining the bisections of the sides of any quadrilateral figure, together constitute a parallelogram.

4. Describe an isosceles triangle having each of the angles at the base double of the angle of the vertex.

Which of the regular polygons depend on this proposition for their construction?

5. Triangles of the same altitude are as their bases.

6. If from the angle of a triangle a straight line be drawn perpendicular to the base, the rectangle contained by the sides of the triangle is equal to the rectangle contained by the perpendicular and the diameter of the circumscribing circle.

If D be the diameter of the circumscribing circle, shew that the prism whose base is the given triangle and axis D, is equal to the rectangular solid whose three adjacent sides are equal to the three sides of the triangle.

7. Draw a straight line perpendicular to a given plane from a given point above it.

Shew that this is the least straight line which can be drawn from the given point to the plane.

8. Define the sine, cosine, and tangent of an angle, and trace, in a general way, their magnitudes from 0° to 360°.

Supposing a to be the least value of θ which satisfies the equation $\tan\theta = a$, find all the values of θ which satisfy the same condition.

9. Expand $\sin(A \pm B)$ and $\cos(A \pm B)$ in terms of the sines and cosines of A and B.

10. Find the sines and cosines of 45°, 30°, 18°, 48°.

11. Express $\sin\frac{1}{2}A$ and $\cos\frac{1}{2}B$ in terms of $\cos A$.

Find $\sin 15°$ regarded as the half of 30°, and show that it is identical with $\sin 15°$ regarded as $45° - 30°$.

12. In any triangle $\dfrac{\tan\frac{1}{2}(A-B)}{\tan\frac{1}{2}(A+B)} = \dfrac{a-b}{a+b}$.

In the mensuration of triangles mention the case to which this formula applies.

13. If $S_1 = \tan A + \tan B + \tan C + \&c. =$ sum of the tangents,
$S_2 =$ sum of their products taken 2 and 2,
$S_3 =$ .... 3 and 3,
&c.

shew that $\tan(A + B + C + \&c.) = \dfrac{S_1 - S_3 + S_5 - \&c.}{1 - S_2 + S_4 - \&c.}$

14. Express the sine of any angle of a triangle in terms of its sides.

15. Prove Demoivre's Formulæ when the index is a whole number, and shew that

$$\cos(A + B + C + \ldots) + \sqrt{(-1)}\,.\sin(A + B + C + \&c.)$$
$$= \{\cos A + \sqrt{(-1)}\sin A\}\{\cos B + \sqrt{(-1)}\sin B\}.\{\cos C + \sqrt{(-1)}\sin C\}\&c.$$

16. Shew the use of a subsidiary angle in solving the equation $\cos x + a \sin x = b$.

17. Describe briefly the instruments by which angles in a vertical and those in a horizontal plane are commonly measured.

There is a tower on the other side of a river; show how its height may be determined without crossing the river.

V.—ARITHMETIC AND ALGEBRA.

1. Define Vulgar and Decimal Fractions.

Shew from first principles that $\frac{6}{7} \times \frac{4}{9}$ is equal to $\frac{8}{21}$.

2. Find the sum of $\frac{3}{7}$ of a guinea, ·0125 of £1, ·45 of £5. 10*s.*, and 2·25 of 1*s.* in terms of the decimal of a crown.

Reduce the result to pounds, shillings and pence.

3. What is the amount paid for rent and poor-rates on 12 acres, 1 rood, and 32·5 poles, when the rent is £4 per acre and the poor-rates 4*s.* in the pound on the rent?

4. Define Discount and Present Worth.

A bill of £2241. 15*s.* is due two years hence: find the present worth allowing 5 per cent. compound interest.

What is the discount per cent.?

5. a and b are the lengths of two lines drawn from a certain point and terminated by the concave part of the circumference of a circle; the first is bisected, the second trisected, by the convex part of the circumference, express the relation between a and b.

6. Prove the rule for finding the greatest common measure of two integers. Hence shew that if a is prime to b, and divides bc, it divides c. Hence shew that if N is a whole number, $\sqrt[n]{(N)}$ is a whole number or incommensurable.

7. Simplify the expressions:

$$(1)\quad \frac{a - \sqrt{b}}{c + \sqrt{d}} + \frac{a + \sqrt{b}}{c - \sqrt{d}}.$$

$$(2)\quad \frac{x + 1}{2(x^2 + 1)} - \frac{1}{(x^3 + 1)(x^2 + 1)} + \frac{1 - 2x}{3(x^2 - x + 1)}.$$

8. If $r_1, r_2, \ldots r_n$ be the remainders, when

$$x^n + p_1 x^{n-1} + p_2 x^{n-2} + \&c. + p_n$$

is divided by $(x + a)$, n times in succession, then

$$x^n + p_1 x^{n-1} + \&c. + p_n = (x + a)^n + r_n (x + a)^{n-1} + r_{n-1}(x + a)^{n-2} + \&c. + r_1.$$

Ex. $x^8 + 5x^6 + 6x^4 + 5x^2 + 1 = (x^2 + 2)^4 - 3(x^2 + 2)^3 + 9(x^2 + 2) - 9.$

9. Solve the equations:

$$(1)\quad \frac{2x + 3}{x + 1} - \frac{3x - 7}{3x - 1} = 2. \qquad (2)\quad 3\sqrt{(x)} - \sqrt{(x + 16)} = 4.$$

$$(3)\quad x^2 + yz = c^2,\ \ y^2 + xz = c^2,\ \ z^2 - xy = a^2.$$

How do you account for the fact that one of the values of x which you obtain from (2) does not satisfy the equation?

10. Shew that the ratio of two quantities $a : b$, may be properly represented by the fraction $\frac{a}{b}$.

If
$$a : b :: a_1 : b_1 :: a_2 : b_2, \&c.,$$
$$a : a + b :: a_1 : a_1 + b_1,$$
$$ma + nb : pa - qb :: ma_1 + nb_1 : pa_1 - qb_1,$$
$$(a^2 + a_1^2 + a_2^2 + \&c.)^{\frac{1}{2}} : (b^2 + b_1^2 + b_2^2 + \&c.)^{\frac{1}{2}}$$
$$:: na + n_1 a_1 + n_2 a_2 + \&c. : nb + n_1 b_1 + n_2 b_2 + \&c.$$

11. If ${}_nP_r$ denote the number of permutations of n things r together, shew from first principles that

$${}_nP_r = (n - r + 1)\,{}_nP_{r-1}.$$

Prove the formula ${}_nP_r = n\,.\,(n - 1)\ldots(n - r + 1)$.

In how many ways may seven men and four boys be arranged round a circular table, so that all shall not have the same neighbours in any two arrangements, on the supposition that the boys always sit together?

12. Assuming the truth of the Binomial Theorem for positive integral indices, prove it for fractional and negative indices.

Solve the equation $ax^2 - 4x + 4 = 0$, and find the values of the roots when $a = 0$.

13. If $A \propto B$ when C is constant, and $\propto \frac{1}{C}$ when B is constant; then when both vary, $A \propto \frac{B}{C}$.

If 10 men can reap 20 acres of corn in 6 days of 14 hours a day, how many will be required to reap 6 acres in $1\frac{3}{4}$ days of 8 hours a day?

14. Obtain the values of x which give the fraction $\frac{x+4}{(x+5)(x+6)}$ maximum and minimum values; and shew that the greatest of the two values of the fraction is a minimum, and the least a maximum.

15. Shew that whatever be the scale of notation, any number will be divisible by the number represented by 11 in that scale, if the difference between the sum of the even and the sum of the odd digits is 0, or a multiple of 11. In the decimal scale shew that if a number be not divisible by 7, we may determine, by inspection, all the divisors of that number which are less than 13. Ex. 16589352.

16. Sum the series

(1) $1 + 3x + 5x^2 +$ &c. to n terms. (2) $1^3 + 2^3 + 3^3 +$ &c. to n terms.

If S be the sum of n terms of the series $1^r + 2^r +$ &c., $\frac{S}{n^{r+1}} = \frac{1}{r+1}$, when n is indefinitely increased.

17. The squares of the periodic times of the planets vary as the cubes of their distances from the Sun. The periodic time of Neptune : the periodic time of the earth :: 164.5 : 1. Compare their distances from the Sun and their velocities in their orbits.

(Find these ratios correct to 3 places of decimals.)

SCHOLARSHIP EXAMINATION.

ST. PETER'S COLLEGE. *June*, 1861.

I.

I. (1) Ἡρόδοτος ὁ μυθολόγος, ARIST., *H. A.*, III. 5.

Discuss the appropriateness of this epithet.

(2) What is known of Periander? Give the date of the period during which he ruled in Corinth.

(3) Name the most important Greek settlements in Sicily, mentioning their several *μητροπόλεις*. Hence account for the parts played by the Sicilian towns in the Peloponnesian War.

(4) What was the occasion of the speech "De falsâ Legatione"? Briefly sketch the public life of Demosthenes, and deduce an estimate of his public character.

Translate, with brief notes where necessary:

II. *From* Ἐπεὶ δὲ, τοῦ χρόνου....
to ....ὁ δὲ παῖς οἱ ἐς τὴν Κόρινθον.
HEROD., III. 53.

III. *From* Ὅ, τε ἐκ τῆς γῆς πεζὸς ἀμφοτέρων, ...
to ....πολυειδῆ ἀναγκάζοιτο φθέγγεσθαι.
THUCYD., VII. 71.

IV. *From* Ἀνάγκη δή που τοὺς λόγους....
to ....ἅπαξ ἀπολωλέναι δίκαιος.
DEMOSTH., *De. Fals. Leg.*, 373, 374.

V. Translate into Greek Prose:

The contention that ensued is one of the best attested but most improbable events in the history of mankind. The troops, as if satiated with the exercise of power, again conjured the Senate to invest one of its own body with the Imperial purple. The Senate still persisted in its refusal; the army in its request. The reciprocal offer was pressed and rejected at least three times, and, whilst the obstinate modesty of either party was resolved to receive a master from the hands of the other, eight months insensibly elapsed: an amazing period of tranquil anarchy, during which the Roman world remained without a sovereign, without an usurper, and without a sedition. The generals and magistrates appointed by Aurelian continued to exercise their ordinary functions; and it is observed that a pro-consul of Asia was the only considerable person removed from office in the whole course of the interregnum.

GIBBON.

II.

Translate the following passages, explaining geographical and historical allusions, and remarking on peculiarities of construction:

1. *From* Χώρει νυν· ὡς σὴν πρὸς κασιγνήτην....
to ....τὸ λοιπὸν εὐτυχοῖεν ἄν.

HOMER, *Odys.*

2 *From* Ἔθρεψεν δὲ λέοντα....
to ....καλλίπαις πότμος ἀεί.

3. *From* Γλαυκᾶς, ὦ φιλέριθ' ἀλακάτα,....
to ....πάντα δὲ τιμᾶντα τὰ πὰρ φίλων.

THEOCRITUS, *Idyl.*

4. *From* Ὁ πλοῦτος εὐρυσθενής,....
to ....ποδαρκέων δώδεκ' ἂν δρόμων τέμενος.

ÆSCHYLUS.

5. Translate into Greek Verse:

Pen. If thou hast struck
Some soldier down to vindicate thy freedom,
Who shall accuse thee?
Thoas. 'Twas no soldier, Pentheus;
No stout opponent that my fatal knife
Dismiss'd to Erebus. A wither'd hand
As from an old man, in the gloom stretch'd forth,
Scarce met my touch,—which could not have delay'd
My course an instant:—'twas no thought of fear,
No haste for freedom, urg'd me,—but an oath
Glared on my soul in characters of flame,
And madden'd me to strike. I raised my arm,
And wildly hurl'd my dagger;—naught but air
It seem'd to meet;—but a sharp feeble sigh
Such as death urges when it stops the gasp
Of wasting age, assured me it had done
A murderer's office.
Pen. Think not of it thus:
Thy lips are parch'd,—let me fetch water.
Thoas. No!
I have drunk fiercely at a mountain spring,
And left the stain of blood in its pure waters;
It quench'd my mortal thirst, and I rejoiced,
For I seem'd grown to demon, till the stream
Cool'd my hot throat, and then I laughed aloud,
To find that I had something human still.
Pen. Fret not thy noble heart with what is past.

Thoas. No !—'tis not past !—the murderer has no past ;
But one eternal present.

III.

I. Translate :

From At eodem te, quum cœnavisses, rediturum....
to .... cubiculum transferri non possent ?

Cic. *pro Rege Deiotaro*, VII.

(1) Of what country was Deiotarus king ? Whence its name ?

(2) Give the lineage and the name in full of P. Africanus ; and mention his chief exploits, with dates.

(3) When and under what circumstances did the kingdom of Attalus become a Roman province ?

(4) Trace the steps whereby the geographical expression (Asia) acquired its present extension of meaning.

(5) Explain the grammatical peculiarity of ' perduint.'

II. Translate, explaining fully the historical allusions :

From Haud memorabilem rem per se,....
to ....Idibus Quinctilibus transveherentur.

Livy, IX. 46.

III. Translate :

From Infensior illic miles, culpam....
to ....testis veri opprimeretur.

Tacitus, *Hist.* IV. 25.

(1) Give the modern names and geographical position of the cities here mentioned.

(2) Give the derivations of the following words :

Imperatori : nuntiari : provinciarum : extingui : exemplaria : traderentur : exercitus : Coloniam : enixe : ultro.

IV. Translate into Latin Prose :

His military triumphs awakened no pride nor vainglory, as they would have done had they been effected for selfish purposes. In the time of his greatest power, he maintained the same simplicity of manners and appearance as in the days of his adversity. So far from affecting regal state, he was displeased if, on entering a room, any unusual testimonial of respect were shewn him. If he aimed at universal dominion, it was the dominion of the faith : as to the temporal rule which grew up in his hands, as he used it without ostentation, so he took no step to perpetuate it in his family. The riches which poured in upon him from tribute and the spoils of war, were expended in promoting the victories of the faith, and in relieving the poor among its votaries ; insomuch that his treasury was often drained of its last coin.

IV.

I. Translate into English Prose or Verse :

From O nate, ingentem luctum....
to ....et fungar inani
Munere.

VIRG., *Æn.*, Lib. VI., vv., 868—886.

(*a*) Who was this Marcellus ? To what gens did the Marcelli belong ? Mention any other distinguished Marcelli.

(*b*) What other persons did Augustus adopt ? Give a stemma of the Cæsars, inserting the dates of their respective reigns.

II. Translate into English Prose :

From LE. Minus quindecim dies sunt,....
to ....tui nec miseret, nec pudet.

PLAUT., *Trinumm.*, Act II., Sc. 4, vv. 1—30.

(*a*) Give a brief sketch of the history of Roman Comedy ; explaining incidentally the terms *ludiones*, *Fescennina*, *exodia*, *satura*, *palliata*, *togata*, *mimus*, *Atellana fabula.*

(*b*) Describe the different methods of sale in use at Rome.

III. Translate into English Prose :

From Hoc, quodcunque vides....
to ....Fidenas longe erat ire, via.

PROPERT., LIB. V., el. I., vv. 1—36.

(*a*) For what purpose do you suppose this elegy to have been written ? What similar undertakings were accomplished by Greek and Roman poets ?

(*b*) Draw a plan of Rome at the time of Augustus, indicating especially the places mentioned in this passage.

(*c*) *ubi Navali stant sacra Palatia Phœbo.* In memory of what victory was this temple built by Augustus ?

(*d*) *Tarpeius pater.* What god was this ? What celebrated men met with their death by being hurled from the Tarpeian rock ?

(*e*) *externos divos.* What foreign Cults had been introduced into Rome at the time of the composition of this elegy ?

(*f*) Describe the nature of the *Palilia*, *Compitalia*, and *Lupercalia.*

(*g*) Explain the word *Lycmon.* Give Niebuhr's opinion on the nature and origin of the three divisions of the Roman people here mentioned.

IV. Translate into Latin Hexameters :

'Twas on a joyless and a gloomy morn,
Wet was the grass, and hung with pearls the thorn,
When Damon, who designed to pass the day
With hounds and horses, and chase the flying prey,
Rose early from his bed ; but soon he found
The welkin pitched with sullen clouds around,
An eastern wind, and dew upon the ground.
Thus while he stood, and sighing did survey
The fields, and curst the ill omens of the day,
He saw Menalcas come with heavy pace ;
Wet were his eyes, and cheerless was his face ;
He wrung his hands, distracted with his care,
And sent his voice before him from afar.

DRYDEN.

VI.—GEOMETRY.

1. If two angles of a triangle be equal to one another, the sides also which subtend, or are opposite to, the equal angles, shall be equal to one another.

If one angle C of a triangle be equal to the sum of the other two, prove that the side AB, is equal to twice the line joining C with the middle point of AB.

2. If a side of any triangle be produced, the exterior angle is equal to the two interior and opposite angles ; and the three interior angles of every triangle are equal to two right angles.

3. Triangles upon the same base, and between the same parallels, are equal to one another.

If E and D be the points of trisection of the sides AB, AC of a triangle (nearer to A), and F the point of intersection of CD and BE; prove that the triangle BFC is half of the triangle ABC, and that the quadrilateral $ADFE$ is equal to either of the triangles CFE or BDF.

4. If the square described upon one of the sides of a triangle be equal to the squares described upon the other two sides of it; the angle contained by these two sides is a right angle.

5. In every triangle, the square of the side subtending any of the acute angles, is less than the squares of the sides con-

taining that angle, by twice the rectangle contained by either of these sides, and the straight line intercepted between the perpendicular let fall upon it from the opposite angle, and the acute angle.

6. The angles in the same segment of a circle are equal to one another.

AB and AC are given in position, and BC is of constant length; prove that if PB and PC be drawn making any constant angle with AB and AC, the locus of P is a circle.

7. If two straight lines within a circle cut one another, the rectangle contained by the segments of one of them is equal to the rectangle contained by the segments of the other.

With a point A in the circumference of a circle ABC as centre a circle PBC is described cutting the former circle in the points B, C. Any chord AD of the former, meets the common chord BC in E, and the circumference of the other circle in O. Prove that the angles EPO, DPO are equal for all positions of P.

8. Inscribe a circle in a given triangle.

If a triangle be inscribed in another triangle so that the circle inscribed in the one is the circumscribed circle of the other; and if this process is repeated indefinitely, prove that the triangles will tend to become equilateral.

9. Inscribe an equilateral and equiangular pentagon in a given circle.

10. If the lines bisecting the angles at the base of a triangle, and terminated by the opposite sides be equal, prove that the triangle is isosceles.

11. Triangles and parallelograms of the same altitude are one to another as their bases.

ABC and ABF are triangles on the same base in the ratio of 2 to 1; AF and BF produced meet the sides in D and E; in FB, FG is cut off equal to FE, and BG is bisected in O. Prove that $BO : BE :: DF : DA$.

12. From a given straight line to cut off any part required.

13. If a circle be described touching two given circles, prove that the line joining the points of contact always passes through a given point.

Describe a circle touching two given circles and bisecting the circumference of a third circle.

14. Equiangular parallelograms have to one another the ratio which is compounded of the ratios of their sides.

15. If three straight lines meet all in one point, and a straight line stands at right angles to each of them in that point; these three straight lines are in one and the same plane.

Draw a straight line perpendicular to the plane of a triangle such that if any point in it be joined with the angular points of the triangle, these lines shall be severally at right angles to the opposite sides.

16. If a solid angle be contained by three plane angles, any two of them are greater than the third.

VII.—ARITHMETIC AND ALGEBRA.

1. Express the fractions $\frac{37}{46}$, $\frac{78}{97}$ and $\frac{115}{143}$ as fractions having a common denominator, and express the difference of the first two, as a fraction of the difference of the second two.

2. Find the difference of the expense of carpeting a room 17 ft. 9 in. long and 12 ft. 6 in. broad with Brussels carpet $\frac{3}{4}$ yd. wide at 4*s.* 6*d.* per yard, and with Kidderminster $\frac{7}{8}$ th yard wide at 3*s.* 6*d.* per yard.

3. Explain the mode of reducing a vulgar fraction to its equivalent decimal.

When will the decimal be a terminating one, and what will be the number of decimal places?

What will be the number of places in the decimal equivalent to $\frac{98}{28672}$?

4. Find the continued product of the factors

$$x^2 - ax\sqrt{(2)} + a^2,\ \ x^2 + ax\sqrt{(2)} + a^2,\ \ x^2 + ax\,\frac{\sqrt{(3)}+1}{\sqrt{(2)}} + a^2,$$

$$x^2 - ax\,.\,\frac{\sqrt{(3)}+1}{\sqrt{(2)}} + a^2,\ \ x^2 + \frac{\sqrt{(3)}-1}{\sqrt{(2)}}\,ax + a^2,\ \ x^2 - \frac{\sqrt{(3)}-1}{\sqrt{(2)}}\,ax + a^2.$$

5. Investigate a rule for finding the lowest Common Multiple of two algebraical expressions.

Find the lowest Common Multiple of

$$x^4 - x^2 - 2x + 2 \text{ and } 2x^3 - x - 1.$$

6. Write a short dissertation on the theory of indices.

7. Solve the equations:

$$\sqrt{(x^2 + ax + a^2)} + \sqrt{(x^2 - ax + a^2)} = \sqrt{\{2\,(a^2 - b^2)\}}.$$

$$(x^2 + y^2)\,\frac{x}{y} = \frac{100}{3},\quad (x^2 - y^2)\,\frac{y}{x} = \frac{21}{4},$$

$$a^x\beta^y\gamma^z = a,\quad a^y\beta^z\gamma^x = b,\quad a^z\beta^x\gamma^y = c.$$

8. *A*, *B*, and *C* start at the same time for a town *a* miles distant. *A* walks at a uniform rate of *u* miles per hour, and *C* and *B* drive at a uniform rate of *v* miles per hour. After a certain time *B* dismounts, and walks forward at the same

rate as A, while C returns to meet A. A mounts with C, and they enter the town the same time as B, C driving uniformly all the time.

Shew that the whole time of the journey is $\frac{a}{v} \cdot \frac{3v+u}{3u+v}$ hours.

9. Investigate the expression for the number of permutations of n things taken r together.

Shew that the number of permutations of n things taken r together, in which p identical things always occur, is

$$\frac{\lfloor\underline{n-p} \cdot \lfloor\underline{r}}{\lfloor\underline{n-r}\ \lfloor\underline{r-p}\ \lfloor\underline{p}}.$$

10. Prove the Binomial Theorem for a positive integral index.

If $\{5\sqrt{(2)}+7\}^{2r+1} = m + \alpha$, where m is an integer, and α less than unity, prove that $\alpha(m+\alpha) = 1$.

11. Explain the method of converting a vulgar fraction into a continued fraction.

Investigate the relation which exists between any three consecutive convergents to the continued fraction

$$\frac{a}{b_1} + \frac{a}{b_2} + \frac{a}{b_3} + \&c.$$

If $\frac{p_n}{q_n}$ be the n^{th} convergent to the fraction

$$\frac{a}{b} + \frac{a}{b} + \frac{a}{b} + \&c.$$

prove that

$$p_n = ab^{n-1} + (n-2)a^2b^{n-3} + \frac{(n-3)(n-4)}{1.2}a^3b^{n-5} + \frac{(n-4).(n-5).(n-6)}{\lfloor\underline{3}}a^4b^{n-7} + \&c.,$$

$$q_n = b^n + (n-1)ab^{n-2} + \frac{(n-2)(n-3)}{1.2}a^2b^{n-4} + \frac{(n-3)(n-4)(n-5)}{\lfloor\underline{3}}a^3b^{n-6} + \&c.$$

and that $\quad p_1p_2\ldots p_n = a^{n-1}q_1q_2\ldots q_{n-1}$.

12. If $\log_{10}(N+1) - \log_{10}N = D$; prove that

$$\log_{10}(N+\delta) - \log_{10}N = D\delta\left(1 + \frac{1-\delta}{2N}\right) \text{ nearly.}$$

Shew also that in the ordinary case, when N lies between 10,000 and 100,000, and the tables are calculated to 7 places of decimals, the first term of the above approximation will give accurate results.

Given $\log_{10} 101 = 2{\cdot}0043214$, find $\log_{10} {\cdot}00100625$ to the same degree of accuracy.

13. If n be a prime number, and N be not divisible by n, prove that $N^{n-1} - 1$ is divisible by n.

Prove also that $N^{n^r - n^{r-1}} - 1$ is divisible by n^r.

Shew also that any number in the scale whose radix is $2n$, ends in the same digit as its n^{th} power.

14. Find the value of the series

$$n^r - n.(n-1)^r + \frac{n.(n-1)}{1.2}.(n-2)^r - \&c.$$

for all values of r from 0 to $n+1$ inclusive, and prove that

$$\text{Lim}_{n=\infty}\left(\frac{1^r + 2^r + 3^r + \ldots n^r}{n^{r+1}}\right) = \frac{1}{r+1}.$$

15. A digit from 1 to 9 inclusive is raised to the n^{th} power, n being any integer greater than unity. Shew that the chances are 13 to 5 that the digit in the tens' place is even.

VIII.—TRIGONOMETRY.

1. Compare the measures in degrees and in grades of the angle whose circular measure is $\frac{1}{5}\pi$; and find the circular measure of an angle the complement of which contains as many degrees as the supplement of an angle nine times as large contains grades; find the circular measure of $39°.23'.7''$, taking for the value of π the first of its convergents.

2. From a point A outside a circle two lines of equal length AB, AC, drawn to the ends of a diameter BC, cut the circumference in D, E; if BE, CD meet in O, the area of the quadrilateral $ABOC = \frac{1}{2}BC^2 \cot BAC$. Compare that part of the area of the circle which is outside the triangle ABC with that which is included within it.

3. Trace the changes in sign and magnitude of $\sin A - \cos A$ as A changes from zero to four right angles, pointing out the values of A for which the expression is numerically greatest, and least, and also those for which it vanishes. Give also the greatest and least values which the expression assumes.

4. Define the sine and cosine of an angle. If a side BC adjacent to the largest angle C of an obtuse-angled triangle ABC be produced to N, prove from your definitions that

$$\sin ACN = \sin ABC . \cos BAC + \cos ABC . \sin BAC.$$

If one of the acute angles be double of the other, and the sine of the least angle be $= \frac{1}{2}\lambda^{\frac{1}{2}}$, shew that the tangent of the exterior angle

$$= \frac{1-\lambda}{3-\lambda}\sqrt{\left(\frac{4}{\lambda} - 1\right)}.$$

5. Express $\sin\frac{1}{2}A$ and $\cos\frac{1}{2}A$ in terms of $\sin A$, and determine the proper signs of the radicals when $A = 150°$.

If $\sin A$ be expressed as a function of $\sin 6A$, determine by *à priori* reasoning how many values the resulting expression ought to have for a given value of $\sin 6A$.

6. Shew that

$$(1)\quad \sec^2\tfrac{1}{2}\theta \sec\theta \,\frac{\cot^2\frac{1}{2}\theta - \cot^2\frac{3}{2}\theta}{1 - \cot^2\frac{3}{2}\theta} = 8,$$

$$(2)\quad \frac{(\sec\theta\sec\phi + \tan\theta\tan\phi)^2 - (\tan\theta\sec\phi + \sec\theta\tan\phi)^2}{2(1 + \tan^2\theta\tan^2\phi) - \sec^2\theta\sec^2\phi} = \frac{\sec 2\theta \sec 2\phi}{\sec^2\theta\sec^2\phi};$$

$$(3)\quad \{\sec\theta + \operatorname{cosec}\theta(1 + \sec\theta)\}(1 - \tan^2\tfrac{1}{2}\theta)(1 - \tan^2\tfrac{1}{4}\theta)$$
$$= (\sec\tfrac{1}{2}\theta + \operatorname{cosec}\tfrac{1}{2}\theta)\sec^2\tfrac{1}{4}\theta.$$

7. Find the distance between the centers of the inscribed and circumscribed circles of a triangle having one angle $= \frac{1}{3}\pi$, and the opposite and one adjacent side known.

Find the side opposite to the given angle that this distance between the centers may be to the given adjacent side in the ratio of $\sin\frac{1}{3}\pi - \sin\frac{1}{6}\pi : \sin\frac{1}{4}\pi$.

8. If the axis of a sail of a windmill be supposed to move in a plane inclined at a given angle to the horizon, find the inclination of this axis to the horizon when it is midway between its horizontal and its highest position.

If the axis of the sail be supposed to describe a given conical surface about an axis inclined at a given angle to the horizon, shew how to find the inclination of the sail's axis to the horizon when midway between its horizontal and highest position.

9. Assuming De Moivre's Theorem for positive values of the index, prove its truth when the index is fractional or negative. Shew that one side does not possess more values than the other.

Find the value of $\left\{1 + \sqrt{(-1)}\tan\dfrac{\alpha}{n}\right\}^n$ when n increases without limit.

10. Shew how to expand $\sin x$ in powers of x. What would be the expansion if x were measured in seconds? Thence find to three places of decimals $\sin 30''$.

Shew that the cube of the expansion for $\sin x$ is

$$\tfrac{3}{4}\left(\frac{3^2-1}{\lfloor\underline{3}} \,.\, x^3 - \frac{3^4-1}{\lfloor\underline{5}}\, x^5 + \ldots \pm \frac{3^{2n}-1}{\lfloor\underline{2n+1}} \,.\, x^{2n+1} \mp \ldots\right).$$

11. Find the sum to n terms of the following series:

$$\sin\theta + \sin(\theta + a) + \sin(\theta + 2a) + \ldots$$

$$1 + \cos a \,.\, x + \cos 2a \,.\, x^2 + \ldots$$

$$\cos\theta \cos^2\frac{1}{2}\theta \operatorname{cosec}^2\frac{3}{2}\theta + \cos 3\theta \cos^2\frac{3}{2}\theta \operatorname{cosec}^2\frac{3^2}{2}\theta + \cos 3^2\theta \cos^2\frac{3^2}{2}\theta \operatorname{cosec}^2\frac{3^3}{2}\theta, \ldots$$

12. Prove Wallis' Theorem, and thence deduce an expression for $1 . 2 . 3 \ldots\ldots n$ where n is very large.

13. What geometrical interpretation can be given to $\sqrt{(-1)}$? Find all the logarithms of $1 + \sqrt{(-1)}$, and represent their positions in a figure.

IX.—CONIC SECTIONS.

N.B.—The first *seven* questions must be proved geometrically.

1. Define a parabola, its focus, directrix, and axis; and prove that the tangent at any point makes equal angles with the axis and the focal distance.

The tangent at any point P of a parabola, cuts the directrix in Z, and any line is drawn through Z cutting the curve in Q and Q'; prove that, if S be the focus, SQ and SQ' are equally inclined to SP.

2. In the parabola, prove that the sub-normal is equal to half the latus-rectum.

3. If from an external point O, a pair of tangents OP, OQ be drawn to a parabola, and the focus S be joined to the points of contact P, Q; prove that the triangles SOP, SOQ will be similar.

Describe a parabola touching three given straight lines and having its focus in another given line.

4. If from the foci S, H of an ellipse, SY, HZ be drawn perpendicular to the tangent at any point P, prove that Y and Z lie on the circumference of the circle described on the axis major as diameter, and that the rectangle under the perpendiculars is equal to the square on the semi-axis minor.

If CD be the semi-diameter conjugate to CP, and if DQ be drawn parallel to SP, and CQ perpendicular to DQ, prove that CQ is equal to the semi-axis minor.

5. Define conjugate diameters in the ellipse, and prove that if CD be conjugate to CP, then CP shall be conjugate to CD.

6, Given an hyperbola traced upon the paper; shew how to find its foci and asymptotes by a geometrical construction.

7. If through any two points in an hyperbola, a chord be

drawn and produced to meet the asymptotes, prove that the portions of the chord intercepted between the curve and the asymptotes are equal.

8. Explain how a plane curve can be represented by an equation between two variables.

What is the nature and position of the curves represented by the following equations?

(1) $xy(x-y)=0$, (2) $(Ax+By+C)^2+(A'x+B'y+C')^2=0$,

(3) $(Ax+By+C)^3+(A'x+B'y+C')^3=0$. (4) $(r\cos\theta-a)(a\cos\theta-r)=0$.

9. Investigate the equation to a straight line in the form $y=mx+c$, and explain the geometrical signification of the constants m and c, both when the axes are rectangular and oblique.

A straight line QM moves parallel to a given line, one extremity M being terminated in a given straight line AB of constant length, and the other Q in another straight line given in position. If a point P be taken in Q in QM such that $QP:PM::AM:MB$, shew that the locus of P is a parabola whose axis is parallel to QM.

10. Find the expression for the length of the perpendicular drawn from a given point upon a given line, and explain from your figure when the positive and when the negative sign is to be used.

11. If $\alpha=0$, $\beta=0$ be the equations to two straight lines in the form $x\cos\alpha+y\sin\alpha-p=0$, &c. interpret the equations $l\alpha+m\beta=0$, $l\alpha-m\beta=0$, $m\alpha+l\beta=0$, $m\alpha-l\beta=0$, for a given position of the origin.

CAB is a triangle, and P and Q are points such that

$$\frac{\sin PAB}{\sin PAC}=\frac{\sin PBA}{\sin PBC}, \text{ and } \frac{\sin QAB}{\sin QAC}=\frac{\sin QBC}{\sin QBA};$$

prove that the locus of P is a straight line, and that the locus of Q is a conic touching the sides of the triangle at A and B and passing through the centre of the circle inscribed in the triangle ABC.

12. Find the equation to the tangent at any point of a parabola.

Find the locus of the points of intersections of tangents to a parabola which include a constant angle.

13. Tangents are drawn to a parabola from an external point (h, k); find the equation to the chord of contact.

From every point of the parabola $y^2=4bx$, tangents are drawn to the parabola $y^2=4ax$, prove that the locus of the middle points of the chords of contact is $y^2=\dfrac{4ab}{2b-a}x$.

14. Write down the relation connecting conjugate diameters in an ellipse, and find the equation to an ellipse referred to semi-conjugate diameters as axes.

15. Prove that the polar equation to a line passing through two points P, Q, of an ellipse or hyperbola is

$$\frac{l}{r} = e \cos\theta + \cos(\theta - a) \,.\, \sec\beta,$$

the focus being pole, the axis major prime radius, and $(a - \beta)$, $(a + \beta)$ the angular co-ordinates of the points P and Q.

P is a point on a conic, Q and Q' points on another conic having the same focus S, and such that the angles QSP and $Q'SP$ are constant; prove that the locus of the intersection of the tangent at P and the chord QQ' is another conic.

16. Find the condition that the general equation of the second degree may represent (1) a parabola, and (2) an ellipse.

Prove that the co-ordinates of the focus of the parabola, whose equation is $A^2x^2 - 2ACxy + C^2y^2 + 2Dx + Ey + 1 = 0$,

are $$\frac{C^3 + C^2E + A^2C + 2ADE}{2(A^2 + C^2)(AE + CD)} \text{ and } \frac{A^3 + A^2D + AC^2 + 2CDE}{2(A^2 + C^2)(AE + CD)},$$

the axes being rectangular.

17. Find the equation to a conic inscribed in a triangle.

Two conics are inscribed in a triangle CAB, each touching the base AB in the same point D, and intersecting in the points P, Q; prove that the chords of contact of the conics with the other sides, the common chord PQ, intersect in a fixed point in AB.

Find also the equations to CP and CQ and shew, that in the particular case when CD bisects the angle ACB, CP and CQ are equally inclined to the sides.

SCHOLARSHIP EXAMINATION.

JESUS COLLEGE. *October*, 1861.

I.

Translate, with notes:

From Ἀκούετε ὦ ἄνδρες....

to ....λαβὼν αὐτὰς τὰς μαντείας.

DEM., *Meidias*, 529, 530.

From Αὐτὰρ ἐπεὶ ψυχὰς μὲν ἀπεσκέδασ' ....
to ....μαχεούμενον ἠδὲ γυναικῶν;
Hom., *Od.*, xi. 385—403.

From Ὦ μῖσος, ἥκεις; εἷλέ σ' ἡ Δίκη χρόνῳ;....
to ....πολλὰ πήματ' ἐξειργασμένον.
Eur., *Herac.*, 941—960.

II.

Translate into Greek Prose:

On every side the prospect was gloomy, no less than the retrospect was painful; yet, though scarcely a ray of hope was visible, the strong heart of the people, which had sustained it in so many desperate conflicts, did not sink even now; and with a spirit worthy of the best days of the Persian wars they calmly applied themselves to examine their wants and their resources, and to prepare, as well as they could, for the new emergency. It was necessary to procure timber, for the building of a new navy, to raise funds for fitting it out. The utmost vigilance was requisite to keep down the disposition to revolt among their allies, more particularly in Eubœa, on which their very subsistence might sometimes depend. The indispensable service of the state demanded the retrenchment of all superfluous expenses.

Thirlwall.

Translate into Greek Iambics:

This is the place, the centre of the grove.
Here stands the oak, the monarch of the wood:
How sweet and solemn is this midnight scene!
The silver moon, unclouded, holds her way
Thro' skies, where I could count each little star.
The fanning west-wind scarcely stirs the leaves;
The river, rushing o'er its pebbled bed,
Imposes silence with a stilly sound.
In such a place as this, at such an hour,
If ancestry can be in aught believ'd,
Descending spirits have convers'd with man,
And told the secrets of the world unknown.

Home.

III.

Translate:

1. *From* Quum ante lucem IIX. Kal. Litteras....
   to ....opus erit in sumptum eroget.
   Cic. *Epp. ad Atticum* VIII. 5.
2. *From* Ceterum tanta fuga ex urbe facta erat,....
   to ....aut signum consecratum esset.
3. *From* Quam, dum pectendos....
   to ....fuerit præsentior, edam.
4. *From* Quo magis his credas,....
   to ....nec quemquam statuit.
   Hor. *Sat.* II. II. 112—230.

IV.

Translate into Latin Prose:

He thought the people, sick of an effete government, would be quiescent, and his uninterrupted good fortune, matchless genius, and vast power, made him disregard ulterior consequences. Hence the cravings of his military and political system, the dangerous vicinity of a Bourbon dynasty, and still more the temptation offered by a miraculous folly, outrunning even his desires, urged him to a deed, which, well accepted would have proved beneficial to the people, but enforced contrary to their wishes was unhallowed by justice or benevolence. In an evil hour for his own greatness and the happiness of others he commenced the fatal project. Founded in violence, attended with fraud, it spread desolation through the Peninsula, was calamitous to France, destructive to himself, and the conflict between his hardy veterans and the vindictive race he insulted was of unmitigated ferocity; for the Spaniards defended their just cause with proverbial, hereditary cruelty, while the French struck a terrible balance of barbarous actions.

Into Latin Verse:

Hence matchless courage. On Cremera's bank,
Hence fell the Fabii; hence the Decii died;
And Curtius plunged into the flaming gulf.
Hence Regulus the wavering fathers firmed,
By dreadful counsel never given before;
For Roman honor sued, and his own doom.

Hence he sustained to dare a death prepared
By Punic rage. On earth his manly look
Relentless fixed, he from a last embrace,
By chains polluted, put his wife aside,
His little children climbing for a kiss;
Then dumb through rows of weeping, wondering friends,
A new illustrious exile! pressed along.

V.—EUCLID AND ALGEBRA.

1. If $\frac{1}{b} + \frac{1}{c} = \frac{4}{a}$, shew that

$$(a + b - c)^3 + 2(b + c - a)^3 + (c + a - b)^3 = 2(b + c)^3.$$

2. In obtuse-angled triangles, if a perpendicular be drawn from any of the acute angles to the opposite side produced, the square of the side subtending the obtuse angle is greater than the squares of the sides containing the obtuse angle, by twice the rectangle contained by the side upon which, when produced, the perpendicular falls, and the straight line intercepted without the triangle, between the perpendicular and the obtuse angle.

ABC is a triangle having a right angle at *A*. From *B* and *C* draw lines bisecting *AC*, *AB*, and meeting a line drawn through *A* parallel to *BC* in *D* and *E*. Prove that $BD^2 + CE^2 = 5BC^2$.

3. Prove that a quadratic equation cannot have more than two roots. If one-third of the sum of the squares of the roots of the equation $ax^2 + bx + c = 0$, be equal to their product, then $b^2 = 5ac$.

Solve the equations

(1) $(a - x)^2 + (b - y)^2 = 2(a + x)(b + y)$, $4xy = (a - b)^2$.

(2) $x(x + 4y) = 9$, $y(y + 3z) = 22$, $z(2z + 3x) = 33$.

4. A person walking at a given rate along a road parallel to a railway, is overtaken and met by two trains travelling at given rates, and he observes that the time each takes in passing him is the same. Compare the lengths of the trains.

5. Shew that $\frac{c + 2a}{c - b} + \frac{c + 2b}{c - a} = 4, > 7$, or > 10, according as c is the Arithmetic, Geometric, or Harmonic mean between a and b.

6. If a straight line touches a circle, and from the point of contact a straight line be drawn cutting the circle, the angles

made by this line with the line touching the circle, shall be equal to the angles which are in the alternate segments of the circle.

P and *Q* are two points in the circumferences of two concentric circles. Shew that the angle included between the tangents at *P* and *Q* is equal to that subtended at the center by *PQ*.

7. Describe a circle passing through a given point, such that the tangent drawn to it from another given point may be equal to a given straight line, and also equal to the chord joining the first point with the point in which the tangent meets the circle.

8. Find the number of different ways in which 10 men can be drawn up in double rank, supposing 3 particular men always in the front and 3 others in the rear.

9. In an expanded binomial the coefficient of the r^{th} term from the beginning is equal to that of the r^{th} term from the end.

Write down the n^{th} term in the expansion of $\left\{n - \frac{x}{\sqrt{(n)}}\right\}^{\frac{1}{n}}$.

If x be very small compared with unity, shew that

$$\frac{1}{1+\sqrt{(1-x)}} - \frac{1}{1+\sqrt[3]{(1-x)}} = \frac{x}{24} \text{ nearly.}$$

10. Prove that every convergent is nearer to the continued fraction than any of the preceding convergents. Find the 5th convergent to $\sqrt{(33)}$.

11. Shew that $m^4 + 2(m^3 + 1)$ is always equal to the sum of two squares.

12. Similar triangles are to one another in the duplicate ratio of their homologous sides.

ABC is an isosceles triangle whose vertex is *A*. From *BA*, *CA*, cut off *BD*, *CE* each equal to *BC*, and join *BE*, *CD* cutting each other in *F*. Shew that if $AC = 25BC$, it equals $35FC$.

13. *P* is any point in the circumference of a circle whose centre is *O*. Join *OP* and produce it to *Q* making *PQ* equal to *n* times *OP*, and from *Q* draw a line touching the circle in *R*. Join *PR* and shew that the diameter of the circle described about the triangle *PQR* equals $(n+1).PR$.

14. Sum $1^2 + 2^2 + 3^2 + \ldots + n^2$, and shew that

$$1.4 + 2.7 + 3.10 + 4.13 + \ldots \text{ to } n \text{ terms} = n(n+1)^2.$$

15. Resolve $\frac{8-x}{(2-x)^2(1+x)}$ into partial fractions, and if it be expanded in a series ascending by powers of x, find the coefficient of x^n.

16. If two straight lines meeting one another, be parallel to two straight lines which meet one another, but are not in the same plane with the first two; the plane which passes through these is parallel to the plane passing through the others.

VI.—TRIGONOMETRY AND GEOMETRICAL CONICS.

1. What are the three principal units in terms of which angles are measured? Shew that the ratio $\frac{\text{arc}}{\text{radius}}$ is a proper measure.

Find the angles which one straight line makes with another upon one side of it when the number of degrees in the one is equal to the number of grades in the other.

2. Define the secant of an angle, and trace the changes in the sign and magnitude of the secant through the four quadrants.

3. Given the sine of an angle, find the sine of half the angle in terms of it.

Shew *à priori* that there ought to be four values indicated in the general result.

4. Prove that (1) $\sin A \pm \sin B = 2 \sin \frac{1}{2}(A \pm B) . \cos \frac{1}{2}(A \mp B)$,

$$(2)\ \tan \theta = \tan \tfrac{1}{3}\theta . \cot \tfrac{1}{3}(\tfrac{1}{2}\pi - \theta) . \cot \tfrac{1}{3}(\tfrac{1}{2}\pi + \theta);$$

and find x from the equation $\sin(3x+a) + \cos(3x-a) = \cos(\frac{1}{4}\pi + x)$.

5. If θ be the circular measure of an angle less than a right angle, prove that $\sin \theta < \theta, > \theta - \frac{1}{4}\theta^3$. Hence shew how a table of sines may be formed.

6. Shew that in any triangle the sines of the angles are proportional to the opposite sides.

A curve on a railway whose form is a circular quadrant has telegraph posts at its extremities, and at equal distances along the arc. A person in one of the extreme radii produced, sees the p^{th} and q^{th} posts from the extremity nearest him (from which his distance is a) in a straight line. Find the radius of the curve.

7. Find the radius of a circle inscribed in a given triangle. The circle inscribed in a triangle ABC touches AC in E. H is the middle point of the line drawn from C to the opposite side, bisecting the angle C. The line EH produced meets CG, a perpendicular to CA, in G. Shew that CG is equal to the radius of the escribed circle opposite to C.

8. Prove that for all values of m, $\cos m\theta + \sqrt{(-1)} \sin m\theta$ is a value of $\{\cos \theta + \sqrt{(-1)} \sin \theta\}^m$. If m be fractional, find the other values.

9. Express any positive integral power of the cosine of an angle in terms of the cosines of its multiples.

10. In the parabola, the rectangle under the latus rectum and the abscissa is equal to the square of a semi-ordinate of the axis.

From S the focus of a parabola a line is drawn parallel to the tangent at a point P meeting the curve in Q; the diameter at P meets SQ in E. Shew that the locus of E is a parabola whose latus rectum is half that of the given one.

11. The perpendiculars from the foci of an ellipse on the tangent intersect the tangent in the circumference of a circle, having the axis major as diameter.

$TYLZ$ is a tangent at L, the extremity of the latus rectum, meeting the axis major in T, and the auxiliary circle in Y, Z. Shew that the ratio $YL : YZ$ is equal to that of the latus rectum to twice the axis major.

12. In the ellipse if the semi-diameter CD is conjugate to CP, then CP is conjugate to CD.

13. If in an ellipse S, H be the foci, P any point, and circles be escribed to the triangle SPH opposite the angles S, H, the product of their radii is constant, and equal to the square on the semi-axis minor.

14. Define an asymptote to a curve, and shew that if from any point of an hyperbola straight lines be drawn parallel to and terminated by the asymptotes, their rectangle is invariable.

SCHOLARSHIP EXAMINATION.

PEMBROKE COLLEGE. *October*, 1861.

I.

Translate into literal English:

From Ἦ ῥα, καὶ Ἕκτορα δῖον....
to ....ὀνομάζων ἄνδρα ἕκαστυν.

HOMER.

From Ἦ ῥα, καὶ ἵππον ἄγων....
to ....χαλεπὸν κατὰ γῆρας ἐπείγει.

HOMER.

From Καὶ βούλεσθε ἀπαγγέλλεσθαι....
to ....ὕστερον, νῦν οὐχ ἁμαρτόντες.

DEMOSTH.

Translate into Greek Iambic Verse:

Dead men and living, vows after vows sent up
In hot succession to the throne of Heaven,
Deep ravage done amongst thy native fields,
Strange tortures suffered by thy countrymen,
Call thee with common voice to turn thy wrath
To just account;—and is it come to this,
That for the matter of but one day's feud
With one tried friend that never did thee hurt,
Thou can'st forget all else, and put thy cause
To imminent hazard at the utmost verge
Of all its fortunes and its ultimate hope?
If so, I cry thee mercy; I mistook thee;
For I had counted on thy aid to-day
To do the things that thou so oft hast threatened.

TAYLOR'S *Philip van Artevelde.*

II.

Translate into literal English:

From Forsitan quispiam dixerit: Nonne igitur....
to ....quam detractio, aut appetitio alieni.

CICERO.

Give some account of Phalaris.

Explain when 'qui' takes a subjunctive.

Define the chief senses of the Latin participles in -dus and in -rus.

From Exoritur Antipatri ratio ex altera parte:....
to ....quia turpe sit, non esse faciendum.

CICERO.

Put down the chief senses of *ratio.*

What is *Finis bonorum?* What were the opinions of the chief sects of philosophers upon it?

Distinguish *num*, *an*, *nonne*, *ne* enclitic.

From Nec tibi tam prudens quisquam....
to ....exciperet cœli indulgentia terras.

VIRG., *Georg.*, II. 315—345.

Translate into Latin Hexameter Verse:

To match this monarch, with strong Arcite came
Emetrius, king of Ind, (a mighty name!)

On a bay courser, goodly to behold,
The trappings of his horse emboss'd with barbarous gold.
Not Mars bestrode a steed with greater grace;
His surcoat o'er his arms was cloth of Thrace,
Adorn'd with pearls, all orient, round, and great;
His saddle was of gold, with emeralds set.
His shoulders large a mantle did attire,
With rubies thick, and sparkling as the fire:
His amber-colour'd locks in ringlets run
With graceful negligence, and shone against the sun.
His age in nature's youthful prime appear'd,
And just began to bloom his yellow beard;
Whene'er he spoke, his voice was heard around,
Loud as a trumpet, with a silver sound;
A laurel wreath his temples, fresh and green,
And myrtle sprigs, the marks of love, were mix'd between;
Upon his fist he bore, for his delight,
An eagle well reclaim'd, and lily-white.

DRYDEN.

III.

Translate into Greek Prose:

For my own part, I must confess, so compassionate is my temper, I wish Polypheme had confined himself to his milk diet, and preserved his eye; nor could Ulysses be much more concerned than myself, when his companions were turned into swine by Circe, who shewed, I think, afterwards, too much regard for man's flesh to be supposed capable of converting it into bacon. I wish, likewise with all my heart, that Homer could have known the rule prescribed by Horace, to introduce supernatural agents as seldom as possible. We should not then have seen his gods coming on trivial errands, and often behaving themselves so as not only to forfeit all title to respect, but to become the object of scorn and derision. A conduct which must have shocked the credulity of a pious and sagacious heathen; and which could never have been defended, unless by agreeing with a supposition to which I have been sometimes almost inclined, that this most glorious poet, as he certainly was, had an intent to burlesque the superstitious faith of his own age and country.—FIELDING.

Translate into Latin Prose :

An enterprising spirit is, however, by no means the character of the present age ; every person who should now leave received opinions, who should attempt to be more than a commentator upon philosophy, or an imitator in polite learning, might be regarded as a chimerical projector. Hundreds would be ready not only to point out his errors, but to load him with reproach. Our probable opinions are now regarded as certainties ; the difficulties hitherto undiscovered as utterly inscrutable : and the writers of the last age inimitable, and therefore the properest models of imitation. One might be almost induced to deplore the philosophic spirit of the age, which in proportion as it enlightens the mind, increases its timidity, and represses the vigour of every undertaking. Men are now content with being prudently in the right ; which, though not the way to make new acquisitions, it must be owned, is the best method of securing what we have. Yet this is certain, that the writer who never deviates, who never hazards a new thought, or a new expression, though his friends may compliment him upon his sagacity, though criticism lifts her feeble voice in his praise, will seldom arrive at any degree of perfection. The way to acquire lasting esteem, is not by the fewness of a writer's faults, but by the greatness of his beauties, and our noblest works are generally most replete with both.

GOLDSMITH.

IV.

1. If two angles of a triangle be equal, the sides opposite to them are also equal.

2. If any side of a triangle be produced, the external angle is equal to the sum of the two internal and opposite angles, and the three internal angles of every triangle taken together are equal to two right angles.

If the diagonals of a quadrilateral be equal and also a pair of opposite sides ; shew that the line joining the middle points of the other two sides passes through the intersection of the diagonals.

3. Divide a straight line into two parts, so that the rectangle under the whole, and one part, may be equal to the square of the other part.

4. If a right line be a tangent to a circle, the right line drawn from the centre to the point of contact is perpendicular to it.

The lines AB, AC touch a circle in the points B and C, and the lines AD, BD are drawn perpendicular to AB and BC respectively. Shew that AD is equal to the radius of the circle.

5. The opposite angles of a quadrilateral figure inscribed in a circle, are together equal to two right angles.

Shew that the quadrilateral described in question (2) can be inscribed in a circle.

6. Equal triangles, which have one angle in each equal, have the sides about the equal angles reciprocally proportional; and two triangles which have one angle equal, and the sides about the equal angles reciprocally proportional, are equal.

Describe a triangle on a given base, and with a given vertical angle, such that the base may be a mean proportional between the sides. Shew that the problem is impossible if the given angle is greater than the angle of an equilateral triangle.

7. If any similar figures be inscribed on the sides of a right-angled triangle, the figure on the side subtending the right angle is equal to the sum of the figures on the other two sides.

8. Find the area of a triangle when the polar co-ordinates of its angular points are given.

Hence find the polar equation to a straight line.

9. Find the tangent of the angle between two lines whose equations are given.

If the angle included by the two lines $x + y = 0$, $y = \sqrt{3} . x$ be equal to $\frac{1}{4}\pi$, what is the angle between the axes?

10. Explain what is meant by the diameter of a curve, and find the diameter of a given system of parallel chords in a parabola.

11. Shew that the normal at any point of an ellipse bisects the angle between the focal distances of that point.

If CY, AZ be the perpendiculars from the center, and an extremity of the major axis on the tangent to an ellipse at any point P, M the foot of the ordinate of P, shew that $CA . AZ = CY . AM$.

12. Define the asymptotes of an hyperbola, and find the equation to an hyperbola referred to its asymptotes as axes.

A tangent at any point P of an hyperbola meets the asymptotes in T, T', and the conjugate hyperbola in Q, Q'. Shew that $QQ' : TT' :: \sqrt{2} : 1$.

V.

1. A shilling weighs 3 dwts. 15 grs., of which 3 parts out of 40 are alloy, and the rest pure silver. How much per cent. is there of alloy, and what is the weight of pure silver?

2. Add together the greatest and least of the fractions $\frac{3}{4}, \frac{7}{8}, \frac{11}{12}, \frac{19}{20}$; and subtract this sum from the sum of the other two fractions.

3. What must be the rate of interest per cent. per annum, in order that the interest on fifty dollars may be one cent. per diem?

4. The cost of carpeting a room, whose length is 18 feet, at 3*s.* 6*d.* a square yard, is £5 12*s.*; and the cost of painting the walls, at 4*s.* 6*d.* a square yard, is £17. Find the height and breadth.

5. Solve the following equations:

$$(1)\quad \frac{\cdot 03}{x} + \frac{\cdot 04}{y} = \cdot 02, \quad \frac{9}{x} - \frac{8}{y} = 1.$$

$$(2)\quad x^{\frac{2}{3}} + y^{\frac{2}{3}} = 25, \quad x^{\frac{1}{3}} + y^{\frac{1}{3}} = 7.$$

$$(3)\quad 6\sqrt{(x^2 - 2x + 6)} = 21 + 2x - x^2.$$

6. Two vessels contain each a mixture of wine and water. In the first vessel the quantity of wine : the quantity of water :: 1 : 3, and in the second :: 3 : 5. What quantity must be taken from each in order to form a third mixture, which shall contain 5 gallons of wine and 9 of water?

7. If $\frac{a}{b}$ be a fraction in its lowest terms, shew that it can be reduced to a finite decimal only when b is of the form $2^r 5^s$; and that in this case the number of decimal places is r or s according as r or s is the greater.

8. Find the number of permutations and combinations of n things taken r and r together.

9. Assuming the Binomial Theorem when the index is a positive integer, prove it when the index is a positive fraction; and apply it to extract the square root of 24 to six places of decimals.

10. Sum the following series:

(1) $2 - 1 + \frac{1}{2} - \frac{1}{4} + \&c.$ to infinity. (2) $1^2 + 2^2 + 3^2 + \&c.$ to n terms.

$$(3)\quad \frac{1}{1.2} + \frac{1}{2.3} + \frac{1}{3.4} + \&c. \text{ to } n \text{ terms.}$$

11. Explain what is meant by the circular measure of an angle; and find to six places of decimals the circular measure of the angle containing 30 minutes.

12. What are the signs of the sine, cosine, and tangent in each of the four quadrants? and between what limits do they lie?

Is the equation $\cos^2\theta = \frac{(a+b)^2}{4ab}$ a possible equation?

13. Give a geometrical proof of the equation $\cos(A - B) = \cos A \cos B + \sin A \sin B$, when A is $< 180°$ and $A - B > 90°$.

14. State the principle on which we may find any trigonometrical function of an angle not exactly contained in the tables.

Prove this principle in the case of the logarithmic sine, and shew that it fails when the angle is nearly 0° or 90°.

15. Explain the ambiguous case in the solution of oblique-angled triangles. If $A = 30°$, $AB = 5$, $BC = 3$, solve the triangle; having given

$$\log 12 = 1{\cdot}0791812; \quad L \sin 56°.26' = 9{\cdot}9207717;$$

difference for $1' = 838$.

16. If α and β be the roots of the equation $x^2 - px + q = 0$, shew that $\tan^{-1}\alpha + \tan^{-1}\beta = \tan^{-1}\frac{p}{1-q}$.

17. Prove the equation $\theta = \tan\theta - \frac{1}{3}\tan^3\theta + \frac{1}{5}\tan^5\theta - \text{\&c.}$, and deduce Machin's series for the determination of π.

18. Describe the principle of the Vernier, and explain its use.

SCHOLARSHIP EXAMINATION.

SIDNEY SUSSEX COLLEGE. *October*, 1861.

I.

Translate, adding a short note wherever a word, a construction, or an allusion seems to require it:

1. *From* Καὶ μὴν Σίσυφον εἰσεῖδον. ..
to ....ἰδὲ γλαυκῶπις Ἀθήνη.

Hom., *Od.*, xi. 592—626.

Quote any examples from ancient or modern poets where the sound is made an echo to the sense.

Write a short account of the various opinions which have been held with respect to the authorship of the Homeric poems.

2. *From* Ἴωνες δὲ καὶ Αἰολέες...
to ....δεησομένους Ἴωσι τιμωρέειν.

Herodotus, i. 141.

Describe briefly the Grecian colonies on the coast of Asia Minor. Do the names afford any clue to the relative dates of the respective settlements?

3. *From* Πάτερ, πιθοῦ μοι, κεἰ νέα....
to ....παθόντα δ' οὐκ ἐπίστασθαι τίνειν.

Soph., *Œd. Col.*, 1181—1203.

What middle tenses are ever used passively, and *vice versâ?*

4. *From* Διὸ δὴ καὶ ἐμήκυνα....
to ....ἢ τοῦ δέους ἀπηλλάγησαν.

Thuc., ii. 42.

Write a summary of the leading events in the Peloponnesian war so far as it has been chronicled by Thucydides.

5. *From* Ὁρῶ, Προμηθεῦ....
to ....ζημία προστρίβεται.

Æsch., *Prom.*, 307—329.

What is meant by the terms 'protasis' and 'apodosis'? Give the different classes of conditional propositions which can be formed with εἰ in the protasis.

6. *From* Ἡ δὲ ὀψιμαθία φιλοπονία....
to ....αὐτὸς αὑτῷ τερετίζων.—Theophr. *Char.*

What were the chief liturgies at Athens?

II.

Translate into Greek Iambics:

Who now persists in calling Fortune false?
To me she has proved faithful; with fond love
Took me from out the common ranks of men,
And like a mother goddess with strong arm
Carried me swiftly up the steps of life.—
Nothing is common in my destiny,
Nor in the furrows of my hand; who dares
Interpret then my life for me, as 'twere
One of the undistinguishable many?
True in this present moment I appear
Fallen low indeed, but I shall rise again;
The high flood will soon follow on this ebb;
The fountain of my fortune which now stops,
Repressed and bound by some malicious star,
Will soon in joy play forth from all its pipes.

Coleridge's *Wallenstein.*

Translate into Greek Prose:

The peace of Constance presented a noble opportunity of establishing a permanent union. But dark, long-cherished hatred, and that implacable vindictiveness which, at least in former ages, distinguished the private manners of Italy, deformed her natural character, which can only be the aggregate of individual passions. For revenge she threw away the pearl of great price, and sacrificed even the recollection of that liberty which had stalked like a majestic spirit among the ruins of Milan. The victim by turns of selfish and sanguinary factions, of petty tyrants, and of foreign invaders, Italy has fallen like a star from its place in heaven; she has seen her harvests trodden down by the horses of the stranger, and the blood of her children wasted in quarrels not their own. Conquering or conquered, still alike a slave; a long retribution for the tyranny of Rome.

HALLAM.

III.

Translate, adding a short note wherever a word, a construction, or an allusion seems to require it:

1. *From* Ipsis doctoribus hoc esse curæ....
   to ....dum omnia timent, nihil conantur.
   QUINTIL., *Instit.*, II. IV.
2. *From* C. Plinius Nepoti suo S.
   Adnotasse videor facta dictaque....
   to ....alia esse clariora, alia majora. Vale.
   PLIN., *Epp.*, III. XVI.
3. *From* Quod te nescio quis....
   to ....jussit abesse focis.
   OVID, *Trist.*, V. XI.
4. *From* M. Cave præterbitas ullas....
   to ....quoi centones farcias.
   PLAUT., *Epidic.*, III. IV.

Translate the following extracts, naming the Author, and explaining the allusions:

1. ....Cujus prudentia monstrat
Summos posse viros et magna exempla daturos
Vervecum in patria crassoque sub aere nasci....

2. Romæ nutriri mihi contigit, atque doceri
Iratus Graiis quantum nocuisset Achilles.
Adjecere bonæ paulo plus artis Athenæ,
Scilicet ut vellem curvo dignoscere rectum,
Atque inter silvas Academi quærere verum.
Dura sed emovere loco me tempora grato,
Civilisque rudem belli tulit æstus in arma
Cæsaris Augusti non responsura lacertis.

3. "Veritatem laborare nimis sæpe, aiunt, extingui nunquam. Gloriam qui spreverit, veram habebit. Sine, timidum pro cauto, tardum pro considerato, imbellem pro perito belli vocent: malo te sapiens hostis metuat, quam stulti cives laudent. Nec ego, ut nihil agatur, moneo; sed ut agentem te ratio ducat, non fortuna: tuæ potestatis semper, tuaque omnia sint. Armatus intentusque sis, neque occasioni tuæ desis, neque suam occasionem hosti des. Omnia non properanti clara certaque erunt: festinatio improvida est et cœca."

4. Quis tulerit Gracchos de seditione querentes,
Quis cœlum terris non misceat et mare cœlo
Si fur displiceat Verri, homicida Miloni,
Clodius accuset mœchos, Catilina Cethegum,
In tabulam Sullæ si dicant discipuli tres?

5. Tu vero felix, non vitæ tantum claritate, sed etiam opportunitate mortis (ut perhibent, qui interfuerunt novissimis sermonibus tuis) constans et libens fatum excepisti; tanquam pro virili portione innocentiam Principi donares. Sed mihi filiæque, præter acerbitatem parentis erepti, auget mæstitiam, quod adsidere valetudini, fovere deficientem, satiari vultu, complexu, non contigit. Excepissemus certe mandata vocesque, quas penitus animo figeremus.

6. Atque utinam his potius nugis tota illa dedisset
Tempora sævitiæ, claras quibus abstulit urbi
Illustresque animas impune et vindice nullo.
Sed periit postquam cerdonibus esse timendus
Cœperat: hoc nocuit Lamiarum cæde madenti.

7. Huic ab adolescentia bella intestina, cædes, rapinæ, discordia civilis, grata fuere; ibique juventutem suam exercuit. Corpus patiens inediæ, vigiliæ, algoris, supra quam cuiquam credibile est; animus audax, subdolus, varius, cujus rei libet

simulator ac dissimulator: alieni appetens, sui profusus; ardens in cupiditatibus: satis eloquentiæ, sapientiæ parum. Vastus animus immoderata, incredibilia, nimis alta semper cupiebat.

8. Hunc exitum habuit, tribus et septuaginta annis quinque principes prospera fortuna emensus, et alieno imperio felicior quam suo. Vetus in familia nobilitas, magnæ opes; ipse medium ingenium, magis extra vitia quam cum virtutibus. Famæ nec incuriosus nec venditator: pecuniæ alienæ non appetens, suæ parcus, publicæ avarus: amicorum libertorumque, ubi in bonos incidisset, sine reprehensione patiens, si mali forent, usque ad culpam ignarus. Sed claritas natalium et metus temporum obtentui, ut quod segnitia erat, sapientia vocaretur. Major privato visus, dum privatus fuit, et omnium consensu capax imperii, nisi imperasset.

9. Hinc ope barbarica variisque Antonius armis,
Victor ab Auroræ populis et litore rubro
Ægyptum viresque Orientis et ultima secum
Bactra vehit; sequiturque (nefas) Ægyptia conjunx.

IV.

Translate into Latin Prose:

Cicero chose the middle way between the obstinacy of Cato and the indolence of Atticus. He preferred always the readiest road to what was right, if it lay open to him; if not, he took the next that seemed likely to bring him to the same end; and in politics, as in morality, when he could not arrive at the true, he contented himself with the probable. He often compares the statesman to the pilot, whose art consists in managing every turn of the winds, and applying even the most perverse to the progress of his voyage; so as by changing his course, and enlarging his circuit of sailing, to arrive with safety, though later, at his destined port. He declared contention to be no longer prudent than either while it did service, or at least, no hurt; but when faction was grown too strong to be withstood, that it was time to give over fighting:—and that nothing was left but to extract some good out of the ill, by mitigating that power by patience which they could not reduce by force, and conciliating it, if possible, to the interests of the state. He made a just distinction between bearing what we cannot help, and approving what we ought to condemn; and submitted therefore, yet never consented, to those usurpations; and when he was forced to comply with them, did it always with a reluctance that he expresses very keenly in his letters to his friends.

MIDDLETON'S *Life of Cicero*.

Translate into Latin Elegiacs;

Fairest flow'r, all flow'rs excelling
Which in Eden's garden grew,
Flowers of Eve's embowered dwelling
Are, my fair one, types of you.

Mark, my Polly, how the roses
Emulate thy damask cheek;
How the bud its sweets discloses;—
Buds thy opening bloom bespeak.

Lilies are, by plain direction,
Emblems of a double kind;
Emblems of thy fair complexion,
Emblems of thy fairer mind.

But, dear girl, both flow'rs and beauty
Blossom, fade, and die away;
Then pursue good sense and duty,
Evergreens that ne'er decay.

COTTON.

V.—ARITHMETIC AND EUCLID.

1. Find the rental of 5 acres, 3 roods, 27 poles, at £1. 12*s*. 8*d*. per acre.

2. Reduce $\frac{689}{901}$ and $\dfrac{11\frac{5}{7} - 7\frac{5}{11}}{3\frac{1}{7} - 3\frac{1}{11}}$ of $\dfrac{\frac{3}{4}}{20\frac{1}{2}}$. Express $2{\cdot}1\dot{3}\dot{6}$ as a vulgar fraction, and $\frac{4}{75}$ as a decimal.

3. How much cotton, 4 feet wide, at 3*d*. per square foot, must be given in exchange for 393·7 metres of French silk, $\frac{3}{4}$ of a yard wide, at 4 francs per square metre: £1 being worth 25·15 francs, and 1 metre being 39·37 inches?

4. What is the amount of £20 in 4 years at 5 per cent. compound interest?

5. Which is the greater rate of interest, £7 for the use of £145, or £4½ for the use of £91. 5*s*. for a year?

6. 3 men, 4 women, 5 boys, or 6 girls, can perform a piece of work in 60 days, how long will it take 1 man, 2 women, 3 boys, and 4 girls, working together?

7. The duty on coffee, roasted or unroasted, is 3*d.* per pound. It loses 18 per cent. in the roasting. If roasted coffee costs 1*s.* per pound before the duty is paid, what ought unroasted coffee to cost, neglecting the expense of roasting?

8. What is meant by *a Definition, an Axiom, a Postulate, a Problem, a Theorem?* Derive the words, and give an example of each. What is meant by a *Reductio ad absurdum* proof?

9. If two triangles have two sides of the one equal to two sides of the other, each to each, and have likewise their bases equal; the angle which is contained by the two sides of the one shall be equal to the angle contained by the two sides equal to them, of the other.

10. If one side of a triangle be produced, the exterior angle is greater than either of the interior opposite angles.

From a given point there can be drawn to a straight line only two straight lines equal to one another.

11. Describe a parallelogram that shall be equal to a given triangle, and have one of its angles equal to a given rectilineal angle.

12. If a straight line be divided into two equal and also into two unequal parts; the squares of the two unequal parts are together double of the square of half the line, and of the square of the line between the points of section.

13. Describe a square that shall be equal to a given rectilineal figure.

Describe a rectangle equal to a given square, and having its adjacent sides together equal to a given straight line.

14. If a point be taken within a circle, from which there fall more than two equal straight lines to the circumference, that point is the center of the circle.

15. Draw a straight line from a given point, either without or in the circumference, which shall touch a given circle.

16. Similar triangles are to one another in the duplicate ratio of their homologous sides.

17. Draw a straight line perpendicular to a plane, from a given point above it.

18. ABC is a triangle having each of the angles at B, C double of that at A, CD is drawn bisecting the angle C and meeting AB in D; shew that BC is a tangent to the circle described about ADC.

19. Draw a circle so as to touch two given straight lines and have a given radius.

20. Two equal circles are described having the center of each in the circumference of the other, and cutting each other in the points A, B; AC is always drawn cutting the cir-

cumferences in D and C; shew that the triangle DBC is equilateral.

VI.—ALGEBRA.

1. Find the numerical value of the expression $\frac{c}{b} \cdot \frac{\sqrt{a} + \sqrt{c}}{\sqrt{a} - \sqrt{c}}$, where a, b, c are connected by the equation

$$a(b - c)^2 - c(b + c)^2 = 0.$$

2. Shew that the difference between the cube of a number consisting of two digits, and the cube of the number formed by changing the places of the digits, is divisible by 27.

3. Define the Least Common Multiple.

State and prove the rule for finding the L. C. M. of two algebraical expressions.

4. Simplify $\sqrt{\{14 - 8\sqrt{(-2)}\}}$.

How can it be determined by inspecting such an expression whether the extraction of the outer square root will simplify it or not?

5. Define joint variation.

Supposing the efficiency of a steam-engine to vary directly as the weight it can raise in a given time through a given distance, and inversely as the quantity of coal consumed in doing so; and supposing the efficiency of an engine which can raise 1 cwt. by a consumption of 1 lb. of coals to be taken as 1; what will be the efficiency of an engine, which can raise 1 ton to the same height in the same time by a consumption of 2 lbs. of coals?

6. Assuming the Binomial Theorem for positive indices, whether integral or fractional, prove it for negative.

7. Solve the equations:

(1) $\sqrt{(2x + 7)} + \sqrt{(3x + 18)} = \sqrt{(7x + 37)}$.

(2) $\frac{x}{y} - \frac{1}{xy} + \frac{y}{x} = 2 = \frac{xy(xy + 1)}{3}$.

(3) $4x^2 + 2xy + \frac{y^2}{4} + \frac{5}{12}(4x + y) = 31, \quad 4x - y - 14 = 0.$

8. Two trains leave London at $2\frac{1}{2}$ hours' interval, and travel at the rate of 19 and 38 miles per hour respectively. On a certain day the first train being detained 50 minutes on the way reached Cambridge only 10 minutes before the second train was due. Find the distance of Cambridge from London.

9. A set out from Cambridge for London, walking, at the same time that B set out from London for Cambridge, on

horseback. A arrived in London, and B in Cambridge, 9 and 4 hours respectively after they met. Find how many hours each required for the journey.

10. In the same time B and C together do thrice as much work as A, and A and C together thrice as much as B. Shew that C by himself can complete a piece of work in a whole number of days only when all three working together can do it in a number of days, which is a multiple of 5.

TRIGONOMETRY.

1. Trace the change in the sign and magnitude of sine A as A increases from 0° to 360°.

2. Define the sine and cosine of an angle, and from the definitions, express $\sin(A - B)$ in terms of the sines and cosines of A and B, when each of the angles A and B is greater than a right angle.

3. In every quadrilateral figure $ABCD$,

$$\frac{\tan A + \tan B + \tan C + \tan D}{\cot A + \cot B + \cot C + \cot D} = \tan A \,.\, \tan B \,.\, \tan C \,.\, \tan D.$$

4. If $\theta + \phi = 240°$, and $\operatorname{vers}\theta = 4 \operatorname{vers}\phi$; find the values of θ and ϕ.

5. Express $66\cdot\dot{6}$ grades in Circular Measure.

6. If the area of the polygon inscribed in a circle be $\frac{1}{4}$th that of the polygon of the same number of sides circumscribed about it; find the number of sides in the polygons.

7. Three objects A, B, and C forming a triangle are visible from a station D at which the sides subtend equal angles. Find AD.

Given $AB = 12$ miles, $AC = 6$ miles; $\angle CAB = 46° \, 34'$;

also $\log 2 = 0\cdot30103$, $\log \cot 53° \, 17' = 9\cdot87264$,

$\log 3 = 0\cdot47712$, $\log \tan 13° \, 57' \, 30'' = 9\cdot39552$,

$\log 5\cdot36 = 0\cdot72916$, $\log \sin 50° \, 40' \, 30'' = 9\cdot88849$.

8. State De Moivre's Theorem, and shew that

$$\{\cos\theta + \sqrt{(-1)}\sin\theta\}^{\frac{m}{n}}$$

has n values which are all different, and only n values.

VII.—CONIC SECTIONS.

1. Define the tangent at a given point in a curve. Prove that the tangent at any point of an ellipse makes equal angles with the focal distances.

2. In an ellipse the rectangle under the abscissa of the axis major is to the square on the semi-ordinate, as the square on the axis major to the square on the axis minor.

3. Define an hyperbola, and prove that the perpendiculars from the foci on the tangent at any point in it, intersect the tangent in the circumference of the auxiliary circle.

4. The asymptote CP of an hyperbola intersects an ellipse whose major and minor axes are respectively its conjugate and transverse axes in the point P, shew that if CP be produced to P' so that $PP' = CP$, and PM, $P'QM'$ be drawn perpendicular to CA meeting it in M, M' respectively, Q being the point of intersection of $P'QM'$ and the hyperbola, QM is the tangent at Q.

5. If from either extremity of an ordinate QVQ', in a parabola, a perpendicular QD is let fall on the diameter, then $QD^2 = 4AS \,.\, SV$.

6. GK is drawn from the foot of the normal PG at a point P in a parabola perpendicular to SP cutting the circle described on SP as diameter in L, LS produced meets the tangent at P in O, shew that the ratio of $OS : OP$ is invariable.

7. Define clearly what is meant by the 'locus of an equation.' Draw the loci of the equations

(1) $x + 2y = 1$. (2) $x^2 - y^2 = a^2$. (3) $\theta = 0$. (4) $\sin 2\theta = a$.

8. Find the equation to the straight line passing through the point of intersection of $2x + 3y - 1 = 0$ and $3x + y - 2 = 0$, and at right angles to the line $5x - 8y + 5 = 0$.

9. AB, AC are two fixed straight lines at right angles: along AB are set off two equal distances AM, MN; shew that if C be a fixed point in AC, and O be the middle point of CM, the straight line ON always passes through a fixed point for all values of AM.

10. Prove by eliminating the term involving xy by transformation of co-ordinates that the equation $x^2 + 2\sqrt{(3)}.xy - y^2 = 0$ represents two straight lines at right angles to each other, and draw them.

11. Prove that the straight line $r \cos(\theta - \alpha) = a\sqrt{(1 - e^2 \sin^2\alpha)}$ touches the ellipse $r^2 = \dfrac{a^2b^2}{a^2 \sin^2\theta + b^2 \cos^2\theta}$ at a point determined by the equation $\tan\theta = \dfrac{b^2}{a^2} \tan\alpha$, e being the eccentricity of the ellipse.

12. Find the equation to the diameter of a given system of parallel chords in an hyperbola.

13. Shew that if P be any point in an ellipse, K the point of intersection of the bisectors of the angles PSH, PHS, and

LKO be drawn perpendicular to the axis cutting the circle described on SH as diameter in L and the axis in O, the area of the triangle SKH varies as OL.

14. Trace the curves:

(1) $r - a\sin\theta = 0$. (2) $4x^2 + 9y^2 - 4x - 6y + 1 = 0$.

(3) $5(x^2 + y^2) - 8xy + 14x - 10y + 9 = 0$.

ENTRANCE SCHOLARSHIP EXAMINATION.

QUEENS' COLLEGE. *October*, 1861.

I.

Translate into literal English:

From Καὶ τότ' ἐγὼ τὸν μοχλὸν....
to ....ἔρριψεν ἀπὸ ἕο χερσὶν ἀλύων.

HOM., *Odyss.*

From Στείχων δ' ἱκνοῦμαι τούσδε....
to ....ὤλετ'· ἆρ' ἔφυν κακός;

SOPH., *Œd. Tyr.*

From ΣΩΚ. Οὐκ οὖν ἓν τῶν ὁμολογουμένων....
to ....ἀντίλεγε, καί σοι πείσομαι.

PLAT., *Crit.*

From Νόμοι τε πάντες συνεταράχθησαν....
to ....εἰκὸς εἶναι τοῦ βίου τὶ ἀπολαῦσαι.

THUCYD. II.

II.

Translate into literal English:

From C. Canius, eques Romanus nec infacetus....
to ....quid accidisset. Stomachari Canius.

CIC., *Off.*

From Romæ aut circa urbem multa ea hieme..
to ....annos respublica eodem stetisset statu.

LIV.

From Quod si forte preces præcordia....
to ....certe mens mea majus agit.

OVID.

From Quid? cum Picenis excerpens semina....
to ....ignoto discet pendentia tergo.
Hor.

III.

Translate into Greek Prose:

If envy, like anger, did not burn itself in its own fire, and consume and destroy those persons it possesses, before it can destroy those it wishes worst to, it would set the whole world on fire, and leave the most excellent persons the most miserable. Of all the affections and passions which lodge themselves within the breast of man, envy is the most troublesome, the most restless, hath the most of malignity, the most of poison in it. The object she hath an immortal hatred to is virtue; and the war she makes is always against the best and most virtuous men, at least against those who have some signal perfection. No other passion vents itself with that circumspection and deliberation, and is in all its rage and extent in awe of some control. The most choleric and angry man may offend an honest and a worthy person, but he chooses it not; he had rather provoke a worse man, and at worst he recollects himself upon the sight of the magistrate. Lust, that is blind and frantic, gets into the worst company it can, and never assaults chastity. But envy, a more pernicious affection than either of the other, is inquisitive, observes whose merit most draws the eyes of men upon it, is most crowned by the general suffrage; and against that person he shoots all his venom, and without any noise enters into all unlawful combinations against him to destroy him.

Translate into Latin Prose:

Let states that aim at greatness, take heed how their nobility and gentlemen do multiply too fast; for that maketh the common subject grow to be a peasant and base swain, driven out of heart, and, in effect, but a gentleman's labourer. Even as you may see in coppice woods; if you leave your straddles too thick, you shall never have clean underwood, but shrubs and bushes. So in countries, if the gentlemen be too many, the commons will be base; and you will bring it to that, that not the hundredth poll will be fit for an helmet; especially as to the infantry, which is the nerve of an army; and so there will be great population and little strength. This which I speak of hath been nowhere better seen than by comparing of England and France; whereof England, though far less in territory and population, hath been (nevertheless) an overmatch; in regard the middle people of England make good soldiers, which the peasants of France do not: and herein the device of King Henry the Seventh (whereof I have spoken largely in the history of his life) was profound and admirable; in making farms and houses of husbandry of a standard; that is, maintained with such a proportion of land unto them as may breed a subject to live in convenient plenty, and no servile condition; and to keep the plough in the hands of the owners, and not mere hirelings.

IV.

Translate into Latin Hexameters:

While thus he spake, the angelic squadron bright
Turn'd fiery red, sharpening in mooned horns
Their phalanx, and began to hem him round
With parted spears: as thick as when a field
Of Ceres, ripe for harvest, waving bends
Her bearded grove of ears, which way the wind
Sways them; the careful ploughman doubting stands,
Lest on the threshing-floor his hopeful sheaves
Prove chaff. On the other side, Satan, alarm'd,
Collecting all his might, dilated stood
Like Teneriff or Atlas, unremoved.
His stature reach'd the sky, and on his crest
Sat Horror plumed: nor wanted in his grasp
What seem'd both spear and shield. Now dreadful deeds
Might have ensued; nor only Paradise
In this commotion, but the starry cope
Of heaven perhaps, or all the elements
At least had gone to wreck, disturb'd and torn
With violence of this conflict; had not soon
The Eternal, to prevent such horrid fray,
Hung forth in heaven his golden scales.

Translate into Greek Iambic Verse:

Well have ye judged, well ended long debate,
Synod of Gods, and, like to what ye are,
Great things resolved, which, from the lowest deep,

F

Will once more lift us up, in spite of fate,
Nearer our ancient seat; perhaps in view
Of those bright confines, whence, with neighbouring arms
And opportune excursion, we may chance
Re-enter Heaven; or else in some mild zone
Dwell, not unvisited of Heaven's fair light,
Secure; and at the brightening orient beam
Purge off this gloom: the soft delicious air,
To heal the scar of these corrosive fires,
Shall breathe her balm. But first whom shall we send
In search of this new world? whom shall we find
Sufficient? who shall tempt with wandering feet
The dark unbottom'd infinite abyss,
And through the palpable obscure find out
His uncouth way, or spread his airy flight
Upborne with indefatigable wings
Over the vast abrupt, ere he arrive
The happy isle?

V.—EUCLID.

1. Give Euclid's definitions of a point, a line, and a surface. What other definitions of them have been suggested by geometers? State which you prefer, and for what reasons.

2. If two triangles have two angles of the one respectively equal to two angles of the other, and a side of the one equal to a side of the other, either the sides adjacent to or opposite to those equal angles; the remaining sides and angles are respectively equal to each other.

If the right lines, drawn from the extremities of the base of a triangle, to meet the opposite sides, and making equal angles with the sides, are equal, the triangle is isosceles.

3. Equal triangles, on the same base and on the same side of it, are between the same parallels.

Trisect a triangle by right lines drawn from a point given in one of its sides.

4. In any triangle the square of the side, subtending an acute angle, is less than the sum of the squares of the sides containing that angle, by twice the rectangle contained by either of them and the segment between the acute angle and the perpendicular let fall from the opposite angle.

Given in any triangle the base, the line bisecting the base, and the sum of the sides, construct the triangle.

5. Draw a right line from a given point either without or in the circumference, which shall touch a given circle.

If three circles touch each other externally and the three common tangents be drawn, these tangents shall intersect in a point equidistant from the points of contact of the circles.

6. The opposite angles of any quadrilateral figure inscribed in a circle are together equal to two right angles.

If perpendiculars be drawn from any point in the circumference of a given circle to the sides of an inscribed triangle, the points where those perpendiculars cut the sides shall lie in the same right line.

7. Upon a given right line describe a segment of a circle which shall contain an angle equal to a given rectilineal angle.

On the same base and on the same side of it two segments of circles are described, and a point is taken in the one from which chords are drawn to the extremities of the base, find the point in the other from which chords being drawn in like manner, the sum of the chords from the point in the one segment shall be equal to the sum of the chords from the point in the other segment.

8. Describe a circle about a given triangle.

If four right lines intersect each other forming four triangles, the circles circumscribing them shall all pass through one point.

9. Give Euclid's definition of proportional magnitudes.

To what objection has this definition been considered liable?

10. In a right-angled triangle, if a perpendicular be drawn from the right angle to the base, the triangles on each side of it shall be similar to the whole triangle and to one another.

Produce a given right line so that the rectangle under it and the produced part shall be equal to a given square.

11. Cut a given finite right line in extreme and mean ratio.

On a given right line construct a right-angled triangle whose three sides shall be in continued proportion.

12. If two right lines meeting one another be parallel to two other right lines which meet one another, but are not in the same plane as the first two, the plane which passes through these is parallel to the plane which passes through the others.

VI.—ALGEBRA.

1. Multiply $a - b$ by $c - d$, where a is greater than b, and c greater than d; and hence deduce the rule of signs in multiplication.

2. Prove the truth of the equation $a^m \times a^n = a^{m+n}$, when m and n are positive integers.

Assuming that the above equation continues true when m and n are negative or fractional, attach a consistent meaning to the expression $a^{\frac{p}{q}}$.

3. Extract the square root of the following quantities:

$1 + x^4 + 6x^3 + 11x^2 + 6x$; ·001, ·1, ·01 to 3 decimal places.

4. Prove a rule for the addition of fractions with different denominators. Simplify the expression

$$\frac{1}{3(1-x)} + \frac{2+x}{3(1+x+x^2)} + \frac{x}{1+x^3}.$$

5. Shew that the greatest common measure of two compound algebraical quantities is the least common multiple of all the common measures.

6. Solve the equations

$$(1)\ \frac{x-1}{2} - \frac{x-2}{3} + \frac{x-3}{4} = \frac{2}{3}. \qquad (2)\ \frac{x}{x+n} + \frac{x+n}{x} = n.$$

$$(3)\ \frac{x}{a} + \frac{y}{b} - 2\left(\frac{x}{a} - \frac{y}{b}\right) = 7, \quad \frac{x^2}{a^2} + \frac{y^2}{b^2} - 4\left(\frac{x^2}{a^2} - \frac{y^2}{b^2}\right) = 5.$$

7. Eliminate x between the equations

$$x^3 + \frac{1}{x^3} + 3\left(x + \frac{1}{x}\right) = m, \quad x^3 - \frac{1}{x^3} - 3\left(x - \frac{1}{x}\right) = n.$$

8. A number consisting of three digits, the absolute value of each digit being the same, is 37 times the square of any digit. Find the number.

9. *A* and *B* run a mile. At the first heat *A* gives *B* a start of 20 yards, and beats him by 30 seconds; at the second heat *A* gives *B* a start of 32 seconds, and beats him by $9\frac{6}{11}$ yards. At what rate an hour does *A* run.

10. Find the sum of n terms of an arithmetic series.

Given the first term and the common difference find n, so that the sum of $2n$ terms may be equal to p times the sum of n terms. Explain the result when $p = 4$, and when $p = 2$.

11. Find the number of combinations of n things taken r together, without assuming the number of variations.

In how many of the combinations do any 3 particular things occur?

12. Prove the Binomial Theorem for a positive integral index.

Find the coefficient of x^n in the expansion of $(1 + x)^{2n}$.

13. Find the number of different ways in which a substance of a ton weight may be weighed by weights of 9 lbs. and 14 lbs.

VII.—TRIGONOMETRY.

1. Shew that the ratio $\frac{\text{arc}}{\text{radius}}$ is a proper measure of an angle.

If the right angle be centesimally divided, and the measure of an angle according to that division be 5·5, where the measure of the right angle is 100, express its magnitude in the common circular measure.

2. Prove the formula $\sin(A+B)=\sin A \cos B+\cos A \sin B$. Hence obtain $\sin 2A$ and $\cos 2A$.

3. Prove the formulæ

$$1 \pm \sin\theta = 2\sin^2\left(\frac{\pi}{4} \pm \frac{\theta}{2}\right), \quad \sin^2\theta \frac{\cos 3\theta}{3} + \cos^2\theta \frac{\sin 3\theta}{3} = \frac{\sin 4\theta}{4}.$$

4. Prove that in any plane triangle of which a, b, c are the lengths of the sides, and A, B, C the magnitudes of the angles,

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}.$$

Hence deduce, for the triangle, the formula

$$\left(\frac{\sin A + \sin B + \sin C}{a+b+c}\right)^2 = \frac{a\cos A + b\cos B + c\cos C}{2abc}.$$

5. Given in any triangle two sides and the included angle, solve the triangle; and adapt your result to logarithmic computation.

6. Express the area of a triangle in terms of its sides.

In the "ambiguous case" find the difference between the areas of the two triangles.

7. A statue 10 feet high, standing on a column 100 feet high, subtends at the eye of an observer in the horizontal plane, from which the column springs, the same angle as a man 6 feet high standing at the foot of the column; find the distance of the observer from the column.

8. Find the radius of a circle inscribed in a triangle.

Find also the radius of the circle which touches one side and the other two produced.

9. A polygon of n sides is inscribed in a circle; find its area; and the area to which it continually approximates as n is increased without limit.

10. If two circles, the radii of which are a and b, touch each other externally; and if θ be the angle contained by the two common tangents to the circles; shew that

$$\sin\theta = 4\frac{(a-b)(ab)^{\frac{1}{2}}}{(a+b)^2}.$$

11. Prove Demoivre's Theorem; and apply it to find the 3 values of $(-1)^{\frac{1}{3}}$.

12. Expand $\sin\theta$ in terms of θ; and prove that

$$2\cos\theta = \varepsilon^{\theta\sqrt{(-1)}} + \varepsilon^{-\theta\sqrt{(-1)}}.$$

13. Prove Machin's series for the value of π.

14. Find the sum of the series

$$\cos\frac{\pi}{n} + \cos\frac{2\pi}{n} + \cos\frac{3\pi}{n} + \ldots + \cos\frac{(2n-1)\pi}{n}.$$

EXAMINATION FOR MINOR SCHOLARSHIPS.

DOWNING COLLEGE. *November*, 1861.

I.

Translate:

From Ὁ ΔΕ Κῦρος, ἅτε παῖς ὢν, καὶ φιλόκαλος....
to ....ἀφικνεῖσθε ὅποι ἡμεῖς πάλαι ἥκομεν.

XENOPHON.

From ΓΕΡΕΑ δὲ δὴ τάδε τοῖσι βασιλεῦσι ...
to ....καὶ τῶν τυθέντων προβάτων τὰ δέρματα.

HERODOTUS.

From ΔΥΝΑΤΩΤΕΡΑΣ δὲ γενομένης τῆς Ἑλλάδος....
to ....Καρκηδονίους ἐνίκων ναυμαχοῦντες.

THUCYDIDES.

From ΤΙ δέ; ἂν αὖ γυμναστικῇ πολλὰ....
to ....καὶ γὰρ ἔοικεν ἔφη.

PLATO.

From ἜΤΙ ἐκ τῶν αὐτῶν καὶ διὰ....
to ....ἀλλὰ πάμπολυ· μᾶλλον δὲ τὸ πᾶν.

ARISTOTLE.

From ὩΣ δ᾽ ὅτ᾽ ὄνος παρ᾽ ἄρουσαν ...
to ....πραπίδων, εἶθαρ δ᾽ ὑπὸ γούνατ᾽ ἔλυσεν.

HOMER.

From ἌΔΜΗΘ᾽,—ὁρᾷς γὰρ τἀμὰ....
to ....ἐξέπραξεν, ὥσθ᾽ οὕτως ἔχειν.

EURIPIDES.

From ΠΑΙΕ, παῖε τὸν πανοῦργον,....
to ....ὡς ὑπ' ἀνδρῶν τύπτομαι ξυνωμοτῶν.

ARISTOPHANES.

1. Ποθοίη, παροψίδας, λεκάνια, ἐλιγμοὺς, ἄγεϊ, ἐξηρτύετο, ἀφνειὸν, ταραξιππόστρατους, Ἡλιασταὶ, φράτορες τριωβόλου. Explain and derive.

2. Δύναμις, ἐνέργεια, ἐντελέχεια. With what distinction of meaning does Aristotle use these words? What is the importance of the last in his scheme of philosophy, and how does Cicero explain it?

3. Give the names and laws, according to Porson or Buttmann, of the common Iambic and Trochaic metres in the passages from Euripides and Aristophanes.

II.

Translate the following passages, and answer the questions appended:

I. *From* Ceterum nemini omnium major justiorque....
to ....suæ ditionis fecisse?

LIVY.

Explain the use of the moods and tenses in the "*oratio obliqua.*" Account for the genitive "*suæ ditionis.*" Give the date of the second Punic War, the principal battles fought during its course, and the ultimate fate of Hannibal.

What was the origin, geographical position, and fate of Carthage?

II. *From* A. d. III. Kal. Maias quum essem....
to ....si, quid maxime expediat, obscurum.

CICERO.

Explain the use of the subjunctive mood in the first sentence. Who formed the first and second triumvirates? What was the battle which decided the fate of the Roman republic? When and for what reason was Cicero put to death?

III. *From* Lauti, cibum capiunt:....
to ....constituunt, dum errare non possunt.

TACITUS.

During the reign of what Roman Emperors did Tacitus live? What other works of his have come down to our time?

Derive *Lauti, conviciis, simplices.*

Give the principal tenses of *adscisco*, *incalesco*, and the plural of *jocus*.

IV. *From* Non hic librorum,....
to ....excusa conditione meæ.

OVID.

What was the name and situation of the place from which Ovid wrote these lines? What modern countries correspond to *Thrace* and *Scythia?* What is the force of *sub* in composition with verbs? What is the corresponding preposition in Greek?

V. *From* Quis te, magne Cato,....
to ....et debellare superbos.

VIRGIL.

Write very brief notices of the persons mentioned in this passage.

VI. *From* Sperne voluptates: nocet....
to ....nunc te melioribus offer.

HORACE.

Who are the "*Siculi tyranni*" here mentioned? Derive *tormentum*.

What is the derivation and original meaning of *pœna?*

What cases do *rego* and *moderor* respectively govern?

III.

Translate into Latin Prose:

And how if you were to die yourself? you know you must; only be ready for it by the preparations of a good life, and then it is the greatest good that ever happened to thee. Else there is nothing that can comfort you: but if you have served God in a holy life, send away the women and the weepers; tell them it is as much intemperance to weep too much as to laugh too much: and when thou art alone, or with fitting company, die as thou shouldest, but do not die impatiently, and like a fox catched in a trap. For if you fear death, you shall never the more avoid it, but you make it miserable. Fannius that killed himself for fear of death, died as certainly as Portia that ate burning coals, or Cato that cut his own throat. To die is necessary and natural, and it may be honorable: but to die poorly, and basely, and sinfully, that alone is it that can make a man unfortunate. No man can be a slave, but he that fears pain, or fears to die. To such a man, nothing but chance and peaceable times can secure his duty, and he depends upon things without for his felicity; and so is well but during the pleasure of his enemy, or a thief, or a tyrant, or it may be of a dog or a wild bull.

JEREMY TAYLOR.

IV.

For Latin Hexameters:

Straight toward Heaven my wondering eyes I turn'd,
And gaz'd awhile the ample sky; till, rais'd
By quick instinctive motion, up I sprung,
As thitherward endeavouring, and upright
Stood on my feet: about me round I saw
Hill, dale, and shady woods, and sunny plains,
And liquid lapse of murmuring streams; by these,
Creatures that liv'd and mov'd, and walk'd or flew;
Birds on the branches warbling; all things smil'd;
With fragrance and with joy my heart o'erflow'd.
Myself I then perus'd, and limb by limb
Survey'd, and sometimes went, and sometimes ran
With supple joints, as lively vigour led:
But who I was, or where, or from what cause,
Knew not; to speak I tried, and forthwith spake;
My tongue obey'd, and readily could name
Whate'er I saw. Thou sun, said I, fair light,
And thou enlighten'd earth, so fresh and gay,
Ye hills, and dales, ye rivers, woods, and plains,
And ye that live and move, fair creatures, tell,
Tell, if ye saw, how I came thus, how here?—
Not of myself;—by some great Maker then,
In goodness and in power pre-eminent:
Tell me, how I may know Him, how adore,
From whom I have that thus I move and live,
And feel that I am happier than I know.—MILTON.

For Latin Lyrics:

THE QUIET LIFE.

Happy the man, whose wish and care
A few paternal acres bound,
Content to breathe his native air
In his own ground.

Whose herds with milk, whose fields with bread,
Whose flocks supply him with attire;
Whose trees in summer yield him shade,
In winter, fire.

Blest, who can unconcern'dly find
Hours, days, and years slide soft away
In health of body, peace of mind,
Quiet by day,

Sound sleep by night; study and ease
Together mix'd; sweet recreation,
And innocence, which most does please
With meditation.

Thus let me live, unseen, unknown;
Thus unlamented let me die;
Steal from the world, and not a stone
Tell where I lie.

POPE.

V.

Translate into English:

From Le bon sens est la chose du monde....
to ....desseins qui passent leurs forces.

DESCARTES. *Discours de la Méthode pour bien conduire sa raison et chercher la vérité dans les Sciences. Premiere partie.*

From Fortune, dont la main couronne....
to ....Et le héros s'evanouit.

ROUSSEAU, J. B., *Ode à la Fortune.*

Translate into French:

Every station of life has duties which are proper to it. Those who are determined by choice to any particular kind of business, are indeed more happy than those who are determined by necessity, but both are under an equal obligation of fixing on employments, which may be either useful to themselves or beneficial to others. No one of the sons of Adam ought to think himself exempt from that labour and industry, which were denounced to our first parent and in him to all his posterity. Those to whom birth or fortune may seem to make such an application unnecessary, ought to find out some calling or profession for themselves, that they may not lie as a burden on the species, and be the only useless parts of the creation.

SPECTATOR, No. 583.

A good conscience is to the soul what health is to the body: it preserves a constant ease and serenity within us, and more than countervails all the calamities and afflictions which can possibly befal us. I know nothing so hard for a generous mind to get over as calumny and reproach, and cannot find any method of quieting the soul under them, besides this single one, of our being conscious to ourselves that we do not deserve them.

GUARDIAN, No. 135.

VI.

Translate into English Prose:

1. *From* Seit dem Anfange des Religionskriegs....
   to ....die er zu vertilgen strebte.
   SCHILLER.
2. *From* Das Princip in der menschlichen....
   to ....Entzweiung betrachten können.
   NEANDER.
3. *From* Das Wundfieber des Kriegs ist gesunder....
   to ....wir für die Zukunft, als Männer?
   JEAN PAUL.
4. *From* Ich freue mich wenn kluge....
   to ....Statt uns zu hintergehen uns belehrt.
   GOETHE, *Tasso*.
5. *From* Ihr naht euch wieder, schwankende Gestalten! ...
   to ....Vom Glück getäuscht, vor mir hinweggeschwunden.
   ID. *Faust*.

Into English Verse or Prose:

6. *From* Wie oft hab'ich in vorger Zeit gestanden,....
   to ....Dies fühl'ich jetzt in mir zurücke kommen.
   TIECK.

VII.

1. If a square described on one of the sides of a triangle be equal to the squares described on the other two sides of it, the angle contained by these two sides is a right angle.

If the equilateral triangle described on one of the sides of a triangle be equal to the equilateral triangles described on the other two sides of it, the angle contained by these two sides is a right angle.

2. Describe an isosceles triangle having each of the angles at the base double of the third angle.

If two diagonals of a regular pentagon be drawn to intersect one another, the greater segments will be equal to the sides of the pentagon.

3. If two triangles have two angles of the one equal to two angles of the other, and one side equal to one side, viz. either the sides adjacent to the equal angles in each, or the sides opposite to them, then shall the other sides be equal each to each, and also the third angle of the one equal to the third angle of the other.

The vertical angle and the sum of the sides of a plane triangle being given, prove that the locus of the middle of the base is a straight line, and find its position.

4. The gross receipts of a railway company in a certain year are apportioned as follows: 41 per cent. to pay working expenses, 56 per cent. to give the shareholders a dividend at the rate of $3\frac{1}{2}$ per cent. on their shares: and the remainder £15,000 is reserved; find the paid up capital of the company.

5. Prove that

(α) $a - (b - c) = a - b + c$.

(β) $$(bx - ay)^2 + (az - cx)^2 + (cy - bz)^2 = (a^2 + b^2 + c^2)(x^2 + y^2 + z^2) - (ax + by + cz)^2.$$

(γ) $$\frac{a^2}{(a-b)(a-c)(x+a)} + \frac{b^2}{(a-b)(c-b)(x+b)} + \frac{c^2}{(a-c)(b-c)(x+c)} = \frac{x^2}{(x+a)(x+b)(x+c)}.$$

6. Solve these equations:

(α) $x^3 - x - 6 = 0$. (β) $\frac{x}{a} + \frac{y}{b} = 1$, $\frac{a}{x} + \frac{b}{y} = 4$.

(γ) $xy + xz = a^2$, $yz + xy = b^2$, $xz + yz = c^2$.

7. Sum a series of quantities in geometrical progression, (1) to n terms, (2) (when possible) to infinity.

If a, b and c are in harmonical progression, prove that

$$\frac{a}{b+c}, \quad \frac{b}{c+a}, \quad \frac{c}{a+b}$$

are also in harmonical progression.

8. Shew that the number of combinations of n things r together is the same as the number $n - r$, together.

There are n points in a plane no three of which are in the same straight line with the exception of p which are all in the same straight line, find the number of lines joining all the points.

9. Apply the Binomial Theorem to expand $(1 - \frac{1}{2}x)^{-2}$ to four terms.

Write down the middle term of $(1 + x)^{2n}$ and shew that $\dfrac{mx^m - nx^n}{m - n} = x^{m+n}$ nearly, if x be nearly equal to 1.

10. Define the cosine of an angle and trace the change in the sign and magnitude of $\cos A$ as the angle changes gradually from 0° to 360°.

Shew that $\tan A = \pm \sqrt{\left(\dfrac{1 - \cos 2A}{1 + \cos 2A}\right)}$, and explain the double sign.

11. By a geometrical construction (or otherwise) prove that

$$\tan(A + B) = \frac{\tan A + \tan B}{1 - \tan A \, . \tan B}.$$

Shew that the tangents of $\frac{1}{3}\pi$, $\frac{1}{4}\pi$, and $\frac{1}{12}\pi$ are in arithmetical progression.

12. Shew by a figure that two angles and a side opposite one of the angles are not always sufficient data for solving a triangle.

Also in a triangle, if $b = a(\sqrt{3} - 1)$, and $C = 30°$, find A and B.

13. Eliminate θ from the equations

$$(a + b)\tan(\theta - \phi) = (a - b)\tan(\theta + \phi), \quad a\cos 2\phi + b\cos 2\theta = c.$$

14. In a parabola the subtangent is equal to twice the abscissa.

15. The tangent at any point of an ellipse makes equal angles with the focal distances.

16. The parallelogram formed by the asymptotes, and straight lines drawn from any point in a hyperbola parallel to the asymptotes is constant for all points of the curve.

17. If a particle be acted upon by forces proportionate to, and represented by, the sides of a polygon, taken in order, the particle will be in equilibrio.

18. Find the ratio of the power to the weight in a system of pullies in which all the strings are attached to the weight.

19. Investigate the condition for the equilibrium of two weights placed on two inclined planes, and supported only by the planes and a string connecting the weights.

OPEN SCHOLARSHIP EXAMINATION.

CHRIST'S COLLEGE. *April*, 1862.

I.

Translate into English, adding a short note where explanation is required:

1. *From* Τὸν δ' ἀπαμειβόμενος προσέφη....
   to ....καὶ ἐνιπλήσασθαι ἀνώγει.
   HOMER, *Odyss.*, VII. 207—221.
2. *From* Βούλομαι τοίνυν ὑμῖν....
   to ....προσήκοντος τύχοι τιμήματος.
   DEMOSTH., *C. Timocratem*, pp. 765-6, §§ 212—214.
3. *From* Intactis opulentior ...
   to ....nefas, aut pretium emori.
   HORACE, *Odes*, III. XXIV. 1—24.
4. *From* Quæcumque in foliis....
   to ....volens atque ora resolvat.
   VIRGIL, *Æn.* III. 445—457.
5. *From* Quæ quum ita sint, paullulum....
   to ....serius veneram, succensuissem.
   CICERO, *De Oratore*, III. 20, §§ 74, 5.

II.—EURIPIDES.

1. What was the origin of the dialogue and choral parts of a Greek Tragedy? In honour of what god were the hymns of the Cyclic Chorus originally sung? Explain how they came to be transferred to the honour of another deity.

2. Mention the festivals of Dionysus at Athens. At which of them were dramatic representations held? At what season were the Great Dionysia held?

3. Explain the terms Cæsura, Anacrusis, Parœmiac, Cretic. What rules are apparently broken in the following lines? Explain or correct them according as they require.

(α) ἡμεῖς μὲν οὐκ ἐῶμεν, οὐδὲ ψαύομεν.
(β) ὅστις δ' ἀνωφέλητα φυτεύει τέκνα.
(γ) οὐδ' ὄρνις εὐσήμους ἀποῤῥοιβδεῖ βοάς.
(δ) οὐκ ἔτι δύναμαι πηγὰς δακρύων,

4, When may *πρὶν ἂν* with the subjunctive be used? Under what circumstances is the *ἂν* omitted? Distinguish between *πρὶν ἂν φανῇ* and *πρὶν φανῆναι*. Distinguish between *οὐ μὴ γράψεις* and *οὐ μὴ γράψῃς*, and shew how the difference of meaning arises.

5. (α) *εἰ μή σ᾽ ἀδελφῆς αἷμα τιμωρήσεται.*

Give Porson's rule for a verb governing *two* accusatives.

(β) *μὴ, πρὸς σὲ θεῶν, τλῇς με προδοῦναι.*

Give the various meanings of *τολμᾷν*.

(γ) *ἀλιβάτοις ὑπὸ κευθμῶσι γενοίμαν.*

What, according to Buttmann, are the derivation and meaning of *ἠλίβατος*?

(δ) *χρὴ δὲ συγγνώμην ἔχειν.*

"Locutio *συγγνώμην ἔχειν* duplicem habet significationem." State what they are, with instances.

(ε) *οἵου στερήσεσθ᾽ ἀνδρὸς!*

How many forms of future tenses with passive signification are found in Greek? Give specimens of each form.

6. Translate:

From *εἶεν. σὺ μὲν κόμιζε....*
to *....πράξαντες οὐ φρονοῦσιν εὖ.*

IPH. TAUR. 342—353.

LIVY. BOOK V.

1. Who first wrote a history of Rome? What were the sources from which he drew his information? On what grounds has the credibility of the early history been denied? Mention any particulars contained in this book of Livy, which do not stand the test of historical criticism.

2. From whence are the Etruscans supposed to have come? What was the nature of their political constitution? When was Etruria finally absorbed by Rome?

3. Explain the following words and expressions:—me dius fidius—fustuarium—agger et vineæ—patrocinium—tributum—triplex stipendium equitibus dedit—Latinæ feriæ—prærogativa (centuria)—cuniculus—intercessores legis—literæ laureatæ—tumultuarius exercitus—flamen—testudo (militaris) and imperium Camillo mandant.

4. Translate:

From Camillus identidem omnibus locis concionabatur:....
to ....Apollini Delphos portaretur.

LIVY, v. c. 25.

Derive anceps, religio, potestas, negotium, cratera.

III.

I. For Greek Iambics:

MEROPE. POLYPHONTES.

M. Such chance as killed the father, killed the sons.
P. One son at least I spared, for still he lives.
M. Tyrants think, him they murder not, they spare.
P. Not much a tyrant thy free speech displays me.
M. Thy shame secures my freedom, not thy will.
P. Shame rarely checks the genuine tyrant's will.
M. One merit then thou hast: exult in that.
P. Thou standest out, I see, repellest peace.
M. Thy sword repelled it long ago, not I.
P. Doubtless thou reckonest on the hope of friends.
M. Not help of men, although perhaps of Gods.
P. What Gods? the Gods of concord, civil weal?
M. No: the avenging gods, who punish crime.

MATTHEW ARNOLD.

II. For Latin Prose:

Notwithstanding these peculiarities, so opposite to the manners of the world, he possessed a thorough knowledge of its affairs: and no sooner was he called by his station, and by the high opinion which Ferdinand and Isabella entertained of him, to take a principal share in the administration, than he displayed talents for business, which rendered the fame of his wisdom equal to that of his sanctity. His political conduct, remarkable for the boldness and originality of all his plans, flowed from his real character and partook both of its virtues and its defects. His extensive genius suggested to him schemes vast and magnificent. Conscious of the integrity of his intentions, he pursued these with unremitting and undaunted firmness. Accustomed from his early youth to mortify his own passions, he shewed little indulgence towards those of other men.

ROBERTSON. (*Character of Cardinal Ximenes.*)

III. For Latin Hexameters.

Now by your children's cradles, now by your fathers' graves,
Be men to-day, Quirites, or be for ever slaves!
For this did Servius give us laws? For this did Lucrece bleed?
For this was the great vengeance wrought on Tarquin's evil seed?
For this did those false sons make red the axes of their sire?
For this did Scævola's right hand hiss in the Tuscan fire?
Shall the vile fox-earth awe the race that stormed the lion's den?
Shall we, who could not brook one lord, crouch to the wicked Ten?
Oh for that ancient spirit which curbed the Senate's will!
Oh for the tents which in old time whitened the Sacred Hill!

MACAULAY. *Virginia.*

IV.—EUCLID.

1. Bisect a given straight line.

2. If the square described upon one of the sides of a triangle, be equal to the squares described upon the other two sides of it; the angle contained by these two sides is a right angle.

3. No two straight lines drawn from the extremities of the base of a triangle to the opposite sides can possibly bisect each other.

4. Two posts being fixed in a playground, a boy has to run from one post up to a wall on one side of the ground and back to the other post: determine the shortest course for him to pursue.

5. If a straight line be bisected and produced to any point; the rectangle contained by the whole line thus produced, and the part of it produced, together with the square of half the line bisected, is equal to the square of the straight line which is made up of the half and the part produced.

6. Upon a given straight line to describe a segment of a circle, which shall contain an angle equal to a given rectilineal angle.

7. Two circles $ABCD$, $EBCF$, having the common tangents AE, and DF cut one another in B and C, and the chord BC is produced to cut the tangents in G and H: shew that the square of GH exceeds the square of AE or DF by the square of BC.

8. If a circle be described passing through A one corner of a square $ABCD$ and through the middle points of the sides

AB, *AD*; shew that a tangent to it from *C* is equal to a side of the square.

9. Inscribe a circle in a given triangle.

10. Similar triangles are to one another in the duplicate ratio of their homologous sides.

11. The rectangle contained by the diagonals of a quadrilateral figure inscribed in a circle, is equal to both the rectangles contained by its opposite sides.

12. From the same point *A*, straight lines are drawn making the angles *BAC*, *CAD*, *DAE*, each equal to half a right angle, and they are cut by a line *BCDE*, which makes *BAE* an isosceles triangle: shew that *BC* or *DE* is a mean proportional to *BE* and *CD*.

13. If in the same circle there be inscribed two triangles of equal area, then the rectangle contained by any two sides of one is to the rectangle contained by any two sides of the other as the base of the second is to the base of the first.

14. If two planes cutting one another be each of them perpendicular to a third plane; their common section shall be perpendicular to the same plane.

V.—ALGEBRA.

1. If $2a = y + z$, $2b = z + x$, $2c = x + y$, find the value of the expression, $a^4 + b^4 + c^4 - 2b^2c^2 - 2c^2a^2 - 2a^2b^2$ in terms of x, y, z, and express $(x + y + z)(xy + yz + zx) - xyz$ in the form of factors involving a, b, c.

2. Prove the rule for finding the Greatest Common Measure of two algebraical quantities; find that of the two quantities

$$ay(x^3 + b^3) + bx(by^2 + a^2x), \quad ax(y^3 + b^3) + by(bx^2 + a^2y).$$

If M is the Least Common Multiple of the three numbers a, b, c, shew what are the conditions that $\dfrac{ab + bc + ca}{M}$ may be integral.

3. Shew fully how the rule for finding the square root of a given number is obtained. If $n + 1$ figures of the square root of a number have been obtained; prove that the remaining n may be obtained by division.

Extract the square root of $x^2(x^2 + y^2 + z^2) + y^2z^2 + 2x(y + z)(yz - x^2)$.

4. Simplify the expression

$$\left[\frac{1}{\{\sqrt{(m)} + \sqrt{(m-n)}\}^2} + \frac{1}{\{\sqrt{(m)} - \sqrt{(m-n)}\}^2}\right]\left[\frac{2}{2m-n} - \frac{1}{m-n}\right].$$

If $(b - c)(bc + x)\alpha = (c - a)(ca + x)\beta = (a - b)(ab + x)\gamma$.

Obtain an equation not containing x.

5. Shew what are the conditions that the equation $ax^2 + 2bx + c = 0$ may have real, equal, or imaginary roots.

Prove that, except zero values, it will not be possible to give values to A, B, C, so that

$$A(x-b)(x-c) + B(x-c)(x-a) + C(x-a)(x-b)$$

may be separable into two linear factors rational as regards a, b, c; a, b, c, being unequal.

6. If A vary as B when C is constant, and as C when B is constant, prove that when B and C both vary A varies as BC.

7. Shew that the fraction $\dfrac{a_1 + a_2 + \dots a_n}{b_1 + b_2 + \dots b_n}$ lies between the greatest and least of the fractions $\dfrac{a_1}{b_1}, \dfrac{a_2}{b_2} \dots \dfrac{a_n}{b_n}$. If these fractions are in ascending order of magnitude, then also the fractions, $\dfrac{a_1 + 2a_2 + a_3}{b_1 + 2b_2 + b_3}, \dfrac{a_2 + 2a_3 + a_4}{b_2 + 2b_3 + b_4}, \dots$ are in ascending order of magnitude.

8. If a number be divided by 9, the remainder is the same as that of the sum of its digits divided by 9.

If the $n + 1$ digits of the number N when expressed in the scale with radix r, be $p_0, p_1, p_2 \dots p_n$, shew that the number $r^{n+1} - (N + 1)$ when expressed in the same scale will have the corresponding $n + 1$ digits

$$r - (p_0 + 1),\ r - (p_1 + 1), \dots r - (p_n + 1).$$

9. Shew how to find the sum of any number of terms of a given geometrical progression; explain what is meant by the sum of an infinite number of terms.

If a, b, c are in Harmonical progression, $a, a - c, a - b$, and $c, c - a, c - b$, are also in Harmonical progression.

10. Find the greatest term in the expansion of $(1 + x)^n$, n being a positive integer.

If the quantities $(1 + x)(1 + x + x^2) \dots (1 + x + x^2 + \dots + x^n)$ be multiplied together, shew that the coefficients of terms equidistant from the beginning and end will be equal; and that the sum of all the odd coefficients is equal to the sum of all the even, each being equal to $\dfrac{\lfloor n+1}{2}$; shew also what is the number of terms.

11. If $\sqrt{(x + a + b)} + \sqrt{(x + c + d)} = \sqrt{(x + a - c)} + \sqrt{(x - b + d)}$, then

$$b + c = 0.$$

If

$$x^2 + y^2 + z^2 = xyz + 4,$$

prove that $(yz - x)^2 + (zx - y)^2 + (xy - z)^2 = (yz - x)(zx - y)(xy - z) + 4$.

12. Solve the equations:

(i) $x^4+2mx^3=2mnx+n^2$. (ii) $(1+x^2)(1+y^2)=2(xy-1)^2$, $x+y=5$.

$$\text{(iii)}\quad \frac{x}{a}+\frac{b}{y}=\frac{c}{x}\quad \frac{y}{d}=\sqrt{\left(\frac{c}{a}\right)}+\sqrt{\left(\frac{b}{d}\right)}.$$

VI.—PLANE TRIGONOMETRY AND CONIC SECTIONS.

1. Prove that concentric circular arcs subtending the same angle are proportional to the radii of the circles; and state clearly what is assumed in the proof.

2. A right angle is sometimes represented by 90°, and sometimes by $\frac{1}{2}\pi$, (π being 3.14159). To what angular units do these respectively refer?

Shew that the angular unit in the latter case contains $57^\circ\ 17\frac{3}{4}'$ nearly.

3. If $\sin\theta=\dfrac{1}{\sqrt{(2)}}$, find a general form for all values of θ, and exhibit them in a geometrical figure.

What will be the corresponding values of $\tan(\frac{1}{4}n\pi\tan\theta)$ according as n is of the form $4p$ or $4p+3$?

4. Prove that $\cos(A+B)=\cos A\,.\cos B-\sin A\,.\sin B$; and draw the figure when A and B are acute angles each greater than half a right angle. Assuming the formula to be true for *all* angles, prove that

$$\sin(A-B)=\sin A\cos B-\cos A\sin B.$$

5. If $\dfrac{x}{a}\cos\alpha+\dfrac{y}{b}.\sin\alpha=\cos\theta$, $\dfrac{x}{y}\tan\alpha=\dfrac{a}{b}$, $z=c\sin\theta$,

then
$$\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}=1.$$

And if also $\dfrac{x'}{a}\cos\alpha'+\dfrac{y'}{b}.\sin\alpha'=\cos\theta'$, $\dfrac{x'}{y'}.\tan\alpha'=\dfrac{a}{b}$, $z'=c\sin\theta$,

then $\dfrac{xx'}{a^2}+\dfrac{yy'}{b^2}+\dfrac{zz'}{c^2}=\cos^2\dfrac{\alpha-\alpha'}{2}.\cos(\theta-\theta')-\sin^2\dfrac{\alpha-\alpha'}{2}\cos(\theta+\theta')$.

6. In any triangle, prove that

$$\sin A=\frac{\sqrt{\{(a+b+c).(b+c-a).(a+c-b).(a+b-c)\}}}{2bc},$$

and hence shew that, in a right-angled triangle, if the sides containing the right angle be nearly equal, each of the other angles will be nearly half a right angle.

7. Find the radius of a circle described about a triangle in terms of the sides; and prove that the rectangle contained by any two sides of a triangle is equal to the rectangle contained by the diameter of the circumscribed circle and the perpendicular let fall upon the remaining side from its opposite angle.

8. Having given two sides of a triangle and the angle opposite to one of them, give formulæ for solving the triangle; and thence shew when there are two triangles, and when only one, corresponding to the same data.

Illustrate this by a figure.

9. Define the tangent of a curve; and shew that at any point of a parabola the line bisecting the angle between the focal distance and perpendicular on the directrix is a tangent.

Shew also that no other line can be a tangent to the parabola at the same point.

10. In a parabola the line joining the middle points of any two parallel chords is parallel to the axis.

Also if the chords be inclined to the axis at an angle of 45°, the line joining their middle points will pass through the extremity of the latus rectum.

11. If the tangent and normal at any point of an ellipse meet the major axis in T and G, prove that

(1) $CT : CA :: CA : CM$. (2) $SG : HG :: SP : HP$.

12. If a circle be described upon the major axis of an ellipse, and two diameters be drawn in it at right angles to each other, meeting the circle in Q, q: and if from Q, q, perpendiculars be drawn to the major axis cutting the ellipse in P, p; D, d, respectively, then PCp, DCd are conjugate diameters of the ellipse.

Give a construction for drawing the *equal* conjugate diameters.

13. Defining an hyperbola to be the locus of a point, the difference of whose distances from two fixed points is equal to a given line; shew what the general form of the hyperbola must be, and draw the conjugate axis.

Define the conjugate hyperbola.

14. The perpendiculars drawn from the foci of an hyperbola upon the tangent at any point, lie in the circumference of a circle described upon the transverse axis.

SCHOLARSHIP EXAMINATION.

EMMANUEL COLLEGE. *April,* 1862.

I.

To be translated into English:

1. *From* Ἐπειδὴ δὲ ἡ θυσία....
to ....παρακέλευσις ἐγίγνετο αὐτῶν.
Xen., *Anab.*, iv. c. 8.

2. *From* Παρῆναι δὲ καὶ τῷ Τισσαφέρνει....
to . . ού προθύμως ξυνεπολέμει.
Thucyd., viii. 46.

3. *From* οὐ γὰρ ἐμοὶ ψυχῆς....
to ....ἕρκος ὀδόντων.
Hom., *Il.*, ix. 401—409.

4. *From* ὅπως δὲ σεμνῶν....
to ....καί με προσβλέψας καλεῖ.
Soph., *Trachin.*, 765—796.

II.

Translate into Greek Prose:

He was a constant cherisher of all those youths in that school, in whom he found either a constant diligence, or a genius that prompted them to learning; for whose encouragement he was (beside many other things of necessity and beauty) at the charge of setting up in it two rows of pillars, on which he caused to be choicely drawn the pictures of divers of the most famous Greek and Latin historians, poets, and orators; persuading them not to neglect rhetoric, because Almighty God has left mankind affections to be wrought upon: and he would often say, 'That none despised eloquence, but such dull souls as were not capable of it.' He would also often make choice of some observations out of those historians and poets; and would never leave the school, without dropping some choice Greek or Latin apophthegm or sentence, that might be worthy of a room in the memory of a growing scholar.

WALTON'S *Lives. Life of Sir H. Wotton.*

Translate into Greek Iambics:

Dar'st thou denie this? wherefore art thou silent?
Speake, and this shall convince thee. Here they are,
I see 'hem, in this Senate, that were with thee.
O you immortall Gods! in what clime are wee?
What region do we live in? in what ayre?
What common-wealth, or state is this we have?
Here, here, amongst us, our owne number, Fathers,
In this most holy Councell of the world,
They are, that seeke the spoyle of me, of you,
Of ours, of all; what I can name 's too narrow:
Follow the Sunne, and find not their ambition.
There I behold, being Consull; Nay, I aske
Their counsels of the State, as from good Patriots:
Whom it were fit the axe should hew in pieces,
I not so much as wound, yet, with my voyce.

BEN JONSON. *Catiline*, Act. IV., Sc. 3.

III.

To be translated into English:

1. *From* Quum censores ob inopiam....
to ....qui accepisset.
LIVY, XXIV., c. 18.

2. *From* Atqui ne ex eo quidem tempore....
to ....ferrum nota recepit?
CICERO, *pro Sextio.*, c. XXXVII.

3. *From* Motum ex Metello consule....
to ....Dalmatico peperit triumpho.
HOR., *Odes*. II., I. 1—16.

4. *From* Ultimus autem....
to ....incenderet ædes.
JUVENAL, *Sat.* III., 209—222.

IV.

Translate into Latin Prose:

The Druids were accustomed to dwell at a distance from the profane, in huts or caverns, amid the silence and gloom of the forest. There, at the hours of noon and midnight, when the Deity was supposed to honour the sacred spot with his presence, the trembling votary was admitted within a circle of lofty oaks, to prefer his prayer, and listen to the responses of the minister. In peace they offered the fruits of the earth: in war they devoted to the god of battles the spoils of the enemy. The cattle were slaughtered in his honour; and a pile formed of the rest of the booty was consecrated as a monument of his powerful assistance. But in the hour of danger or distress human sacrifices were deemed the most efficacious. Impelled by a superstition, which steeled all the feelings of humanity, the officiating priest plunged his dagger into the breast of his victim, whether captive or malefactor; and r om the rapidity with which the blood issued from the wound, and the convulsions in which the sufferer expired, announced the future happiness or calamity of his Country.

LINGARD. *Hist. of Eng.*, ch. I.

For Latin Hexameters:

And ye, Pierian Sisters, sprung from Jove
And sage Mnemosyne,—full long debarred
From your first mansions,—exiled all too long
From many a hallowed stream and grove,
Dear native regions where ye wont to rove,
Chanting for patriot heroes the reward
Of never-dying song!

Now (for, though Truth descending from above
The Olympian summit hath destroyed for aye
Your kindred Deities, ye live and move,
And exercise unblamed a generous sway)
Now, on the margin of some spotless fountain,
Or top serene of unmolested mountain,
Strike audibly the noblest of your lyres,
And for a moment meet my soul's desires!
That I, or some more favoured Bard, may hear
What ye, celestial Maids! have often sung
Of Britain's acts,—may catch it with rapt ear,
And give the treasure to our British tongue!

WORDSWORTH. *Ode. Jan.* 1816.

V.—EUCLID AND GEOMETRICAL CONICS.

1. Define a plane angle, a right angle, a circle and a rhomboid.

2. The opposite sides and angles of parallelograms are equal to one another, and the diameter bisects them, that is, divides them into two equal parts.

Prove also that the two diameters bisect each other.

3. Divide a given straight line into two parts, so that the rectangle contained by the whole, and one of the parts, shall be equal to the square of the other part.

Solve the same problem algebraically, and give the geometrical interpretation of the result.

4. The opposite angles of any quadrilateral figure described in a circle, are together equal to two right angles.

If two opposite sides are equal the other two are parallel.

5. Describe a circle touching one side of a triangle and the other two sides produced.

Also describe a circle touching three sides of a parallelogram.

6. If two triangles have one angle of the one equal to one angle of the other, and the sides about the equal angles proportionals, the triangle shall be equiangular, and shall have those angles equal which are opposite to the homologous sides.

If two straight lines be drawn through the same point A, one touching a circle in B and the other cutting it in C and D, the triangles ABC, ABD are similar.

7. If two straight lines be parallel, and one of them is at right angles to a plane; the other also shall be at right angles to the same plane.

8. Prove that in the parabola, SY is a mean proportional between SP and SA.

If a perpendicular SZ be let fall from S on the normal at P, the locus of Z will be another parabola of which S is the vertex.

9. If NP be the ordinate of a point P in an ellipse whose centre is C, and the tangent at P meet the axis produced in T, prove that $CN \,.\, CT = CA^2$.

Prove also that the subnormal is a third proportional to CT and BC.

10. If CP and CD are semi-diameters in any ellipse and CD be parallel to the tangent at P, CP is also parallel to the tangent at D.

Shew also that the distance of D from the axis major bears a constant ratio to the distance of P from the axis minor.

11. Define an asymptote to a curve, and shew that the diagonals of the rectangle formed by drawing tangents at the vertices of an hyperbola and its conjugate are asymptotes to both curves.

VI.—ALGEBRA AND TRIGONOMETRY.

1. Find the amount of £62. 10*s.* in four years at 20 per cent. per annum compound interest.

2. Shew that when n is integral $\dfrac{n\,.\,\overline{n+1}\rceil\,\overline{2n+1}\rceil}{6}$ is also an integer.

Find the forms of n for which this integer will be even.

3. Extract the square root of

$$(m+n)^2 - 4(m-n)\sqrt{(mn)}.$$

What condition must numerical values of m and n satisfy that the root may be rational?

4. A contractor engages to execute work in n days. After m days, fearing not to finish in time, he doubles the number of his men and thus finishes p days before the specified time. Find whether or not he would have failed in his contract without increase of labourers.

5. What do you understand by an inductive proof?

Shew by such proof that the sum of the first n odd numbers is n^2.

Prove that the continued product of the first n odd numbers is equal to

$$\frac{2n\,.\,(2n-1)\ldots(n+1)}{2^n}.$$

6. Shew that all the terms of the expansion of $\overline{a-x}\rceil^{-\frac{p}{q}}$ in ascending powers of x are positive.

Approximate to $\sqrt{(2)}$ by the form $(1-\frac{1}{2})^{-\frac{1}{2}}$.

7. If $\dfrac{p_n}{q_n}$ be the n^{th} convergent to $a+\cfrac{1}{a+\cfrac{1}{a+\&c.}}$ shew that

$$p_n = ap_{n-1} + p_{n-2} \text{ and } q_n = p_{n-1}.$$

8. Shew that $\cos A - \sin A = \sqrt{(2)}\,.\sin(45^\circ - A)$.

Trace the changes in $\sin A + \cos A$, as A changes through the first four quadrants.

9. If $\sin 2\theta = \frac{1}{2}$, find all the values for $\sin\theta$.

Indicate by a figure the angles whose sines must be given by these values.

10. Find the radius of the circle circumscribing a triangle in terms of the elements of the triangle.

Shew that the smaller circle in Euc. IV. 10, is equal to the circle circumscribed about the constructed isosceles triangle.

11. Obtain $\sin^5\theta$ in terms of sines of multiples of θ. Deduce $\sin^6\theta$ in terms of cosines of multiples of θ.

12. Sum the series

$$\frac{\sin\alpha}{2} + \frac{\sin 2\alpha}{2^2} + \frac{\sin 3\alpha}{2^3} + \text{\&c., to 10 terms.}$$

VII.—ALGEBRAICAL GEOMETRY.

1. Find the equation to a straight line which passes through a given point (hk) and makes a given angle (α) with the line $\frac{x}{a} + \frac{y}{b} = 1$.

2. Shew that the equation $3y^2 - 8xy - 3x^2 = 0$ represents two straight lines, and find the angle between them.

3. Investigate the condition necessary that three straight lines whose equations are $u = 0$, $v = 0$, $w = 0$ may meet in a point.

Ex. The three perpendiculars let fall from the angular points of a triangle on the opposite sides all meet in a point.

4. Shew that two tangents can always be drawn to a circle from an external point (hk), and find the equation to the line joining the two points of contact.

If the point (hk) move along a straight line, all the chords of contact will pass though a fixed point.

5. Investigate the equation to the tangent at any point $(x'y')$ of a parabola, and deduce from it the equation to the normal.

How many normals can be drawn to a parabola from a given point?

6. Find the length of the perpendicular from the center on the tangent at any point of an ellipse and the locus of the points of intersection.

7. Find the condition necessary that a given point (x_1y_1) may be the middle point of the chord of an ellipse whose equation is $y = mx + c$, and hence find the locus of the middle points (1) of a system of parallel chords, (2) of all chords whose length is constant $(= 2l)$.

8. Shew that, in the ellipse, if any two parallel tangents be drawn, and the points in which they meet a third tangent be joined with the center, the joining lines will be conjugate diameters.

9. Prove that in an hyperbola a diameter CP and its conjugate do not both meet the curve.

If D be the point in which the conjugate diameter meets the conjugate hyperbola, PD will be bisected by one asymptote and parallel to the other.

10. Find the equation to an hyperbola referred to its asymptotes as co-ordinate axes.

Hence shew that the area of the triangle contained by the tangent at any point and the asymptotes is constant.

11. Find the polar equation to the tangent of a conic section, and apply it to prove that the tangents at the extremities of a focal chord intersect on the directrix.

VIII.—GENERAL PAPER.

1. Any two parallelograms being drawn on two sides of a given triangle as bases, construct a parallelogram on the third side equal to their sum.

2. If AB be the diameter, and AP a chord of a circle, and AQ a chord bisecting angle BAP, prove that the tangent at Q is at right angles to AP.

3. Eliminate x, y and z by cross multiplication from

$$mx = ax + b''y + b'z, \quad my = b''x + a'y + bz, \quad mz = b'x + by + a''z.$$

4. If ${}^nP_r$ denote the number of permutations of n things r together, prove by general reasoning that ${}^nP_r = n \,.\, {}^{n-1}P_{r-1}$.

Three of a cricket club of 20 players can bowl. How many different elevens can be formed?

5. When is an infinite series said to be convergent? Shew that $1 + \dfrac{1}{\sqrt{(2)}} + \dfrac{1}{2} + \dfrac{1}{2\sqrt{(2)}} + \&c.$ is convergent, but that $1 + \dfrac{1}{\sqrt{(2)}} + \dfrac{1}{\sqrt{(3)}} + \dfrac{1}{\sqrt{(4)}} + \&c.$ is divergent.

6. A man spends £n per annum more than his income, which deficit is taken from his capital (originally £p at r interest per £1 per annum). Find how longbefore he will be penniless.

7. Shew that (α) $\log_a (n \,.\, a^p) = p + \log_a n$.

$$(\beta)\ \log_{10}\left(n + \frac{a}{10}\right) = (\log_{10} \overline{n + 1} - \log_{10} n)\, \frac{a}{10} + \log_{10} n$$

correctly to 7 decimal places, if n consist of 5 digits. Does this formula of proportional parts hold for any base?

8. Shew that the ratio $\dfrac{\sin A}{A}$ depends upon the unit of angle by which A is measured.

Find this unit in order that the limit of $\dfrac{\sin A}{A}$ when A is indefinitely diminished may be π.

9. Obtain the greatest value of $\cos\theta + \sin\theta$ for any value of θ.

10. Enunciate Demoivre's Theorem, and assuming it true for positive indices, prove it for fractional indices.

Find the three values of $\{\sqrt{(-1)}\}^{\frac{1}{3}}$.

11. Find the condition that $x^2 + mxy + y^2 + ax + by = 0$ may represent two straight lines.

12. Find the equation to the parabola of which the point a, $2a$ is focus, and $x + y = c$ is directrix. Also the equation to the tangents at extremities of the latus rectum, employing any known property of such tangents.

13. Find the locus of the middle points of chords of the curve $ax^2 + 2bxy + cy^2 = d$, parallel to $y = mx$, and thence find the directions of the axes of the curve.

14. Obtain the equation to the chord joining the intersections of $y = mx$, $y = m'x$, with $ax^2 + bxy + cy^2 + dy = 0$.

Shew that if it subtend a right angle at the origin, it passes through a fixed point in the axis of y.

EXHIBITION EXAMINATION.

TRINITY HALL. *April*, 1862.

I.

Translate into English Prose:

(*α*) *From* Νομίζω τοίνυν ὦ ἄνδρες ...
to ....ὧν ἀπεκρίναντο, καὶ ἀνάγνωθι.

DEMOSTH., *c. Aphob.*, A. p. 826.

Explain the construction of ὧν ἀπεκρίναντο.

(*β*) *From* 'Αλέξανδρος δὲ ἐπ' Αἰγύπτου, ἵναπερ....
to ....ἀφίκετο ἐς 'Ηλιούπολιν.

ARR., *Anab.*, III. 1.

Draw a map of ancient Egypt.

Parse πεπυσμένος, εἰσήγαγε, κατασχών.

(*γ*) *From* Εὕδεις, 'Ατρέος υἱὲ δαΐφρονος,....
to ....ἄλλος ἐρητύειν ἰπέεσσιν.

HOMER, *Iliad*, β. 60—75.

(*δ*) *From* Τὰ μὲν περισσεύοντα τῶν λόγων....
to ....καί γελᾶν 'λευθέρως.

SOPH., *Elect.*, 1288—1300.

Into Greek Iambics:

How fair these air-born shapes! and yet I feel
Most vain all hope but love; and thou art far
Asia! who when my being overflowed
Wert like a golden chalice to bright wine,
Which else had sunk into the thirsty dust.
All things are still: alas, how heavily
This quiet morning weighs upon my heart;
Though I should dream I could even sleep with grief
If slumber were denied not. I would fain
Be what it is my destiny to be,
The saviour and the strength of suffering man,
Or sink into the original gulf of things,
There is no agony and no solace left—
Earth can console, Heaven can torment no more.

SHELLEY. *Prometheus Unbound.*

II.

Translate into English Prose:

A. *From* In Marco Catone, judices,....
to ....sententia mutari nunquam.
CIC., *pro Mur.*, 29.

B. *From* Dum elephanti trajiciuntur,....
to ....victoriam, Romanis portendit.
LIVY, XXI. 29.

C. *From* Audire magnos jam videor....
to ....modos leviore plectro.
HOR., *Od.* II., 1.

Write a short sketch of the state of Rome in the times of which Horace speaks in this ode.

D. *From* Jam levis obliqua subsidit....
to ....timidi piscibus ora Syri.
OV., *Fasti*, II., 457—474.

Write down in Latin: April 15th, 1862.

Into Latin Elegiacs:

This glassy stream, that spreading pine,
Those alders quivering to the breeze
Might soothe a soul less hurt than mine,
And please, if anything could please.

But fixed unalterable care
  Foregoes not what she feels within;
Shews the same sadness everywhere,
  And slights the season and the scene.

For all that pleased in wood or lawn
  While peace possessed these silent bowers,
Her animating smile withdrawn,
  Has lost its beauties and its powers.

Me fruitful scenes and prospects waste
  Alike admonish not to roam:
These tell me of enjoyments past,
  And those of sorrows yet to come.

III.

Into Greek Prose:

His sudden passion was outrageous, but supported by great personal courage. Nothing exceeded his ambition but his avarice; they often accompany, and are frequently and reciprocally the causes and effects of each other; but the latter is always a clog upon the former. He affected good-nature and compassion; and perhaps his heart might feel the misfortunes and distresses of his fellow creatures, but his hand was seldom or never stretched out to relieve them. Though he was an able actor of truth and sincerity, he could occasionally lay them aside to serve the purposes of his ambition or avarice. He was a most complete orator, eloquent, persuasive, strong, and pathetic, as occasion required; for he had arguments, wit and tears at his command. His breast was the seat of all those passions which degrade our nature and disturb our reason. There they raged in perpetual conflict, but avarice, the meanest of them all, generally triumphed.

Into Latin Prose:

When this inventory was read over to the Emperor, he directed me, although in very gentle terms, to deliver up the several particulars. He first called for my scymitar, which I took out, scabbard and all. In the mean time he ordered three thousand of his choicest troops, who then attended him, to surround me at a distance, with their bows and arrows just ready to discharge: but I did not observe it, for mine eyes were wholly fixed upon his Majesty. He then desired me to draw my scymitar, which, although it had got some rust by the sea-water, was in most parts exceeding bright. I did so and immediately all the troops gave a shout between terror and surprise; for the sun shone clear and the reflection dazzled their eyes as I waved the scymitar to and fro in my hand. His Majesty who is a most magnanimous prince, was less daunted than I could expect; he ordered me to return it into the scabbard, and cast it on the ground as gently as I could, about six feet from the end of my chain.

IV.—ENGLISH COMPOSITION.

1. Paraphrase the following passage in prose, so as to shew clearly the full meaning, expressing the sentiments as much as possible in your own words:

Her. Since what I am to say, must be but that
Which contradicts my accusation; and
The testimony on my part, no other
But what comes from myself; it shall scarce boot me
To say, *Not guilty:* mine integrity,
Being counted falsehood, shall, as I express it,
Be so receiv'd. But thus,—If powers divine
Behold our human actions, (as they do,)
I doubt not then, but innocence shall make
False accusation blush, and tyranny
Tremble at patience.—You, my lord, best know,
(Who least will seem to do so,) my past life
Hath been as continent, as chaste, as true,
As I am now unhappy; which is more
Than history can pattern, though devis'd,
And play'd to take spectators: For behold me,—
A fellow of the royal bed, which owe
A moiety of the throne, a great king's daughter,
The mother to a hopeful prince,—here standing,
To prate and talk for life, and honour, 'fore
Who please to come and hear. For life, I prize it
As I weigh grief, which I would spare: for honour,
'Tis a derivative from me to mine,
And only that I stand for.

Winter's Tale. Act. III. Sc. II.

2. Write an Essay to which the following passage may serve for motto:

> For praise too dearly loved or warmly sought
> Enfeebles all internal strength of thought;
> And the weak soul, within itself unblest,
> Leans for all pleasure on another's breast.
>
> GOLDSMITH'S *Traveller.*

3. Give as vivid an account as you can of a day's excursion in any scenery that is familiar to you.

V.—EUCLID.

1. If two angles of a triangle be equal to each other, the sides also which subtend, or are opposite to, the equal angles, shall be equal to one another.

When is one proposition said to be the converse of another? Is the converse of a true proposition necessarily true? When is a demonstration said to be *direct*, and when *indirect?* Illustrate all your answers by examples from Euclid.

2. If the square described upon one of the sides of a triangle, be equal to the squares described upon the other two sides of it; the angle contained by these two sides is a right angle.

3. ABC is a triangle having a right angle at C. Points D and E are taken in the base so that $AD = AC$ and $BE = BC$, and D and E are joined with C. Shew that the angle DCE equals half a right angle.

4. The opposite angles of any quadrilateral figure inscribed in a circle, are together equal to two right angles.

If lines be drawn bisecting the angles of any trapezium the quadrilateral which they will form by their intersection may be inscribed in a circle.

5. If from any angle of a triangle, a straight line be drawn perpendicular to the base; the rectangle contained by the sides of the triangle is equal to the rectangle contained by the perpendicular and the diameter of the circle described about the triangle.

6. From each of two opposite angular points of a parallelogram lines are drawn to the points of bisection of the sides containing the opposite angle. Shew that these lines will form a parallelogram whose area will be one-third of that of the whole parallelogram.

TRIGONOMETRY.

7. Define the sine and tangent of an angle, and find the value of the sine and tangent of 510°. Express the sine of an angle in terms of the tangent, and explain the double sign in the result.

Prefix the proper sign when the angle is between 270° and 360°.

8. Prove the formulæ:

$$\tan 3A = \frac{\tan^3 A - 3\tan A}{3\tan^2 A - 1}, \quad \sin A - \sin B = 2\cos\frac{A+B}{2}\sin\frac{A-B}{2},$$

$$\frac{\tan A + \sec A}{\cot A + \operatorname{cosec} A} = \tan\left(45 + \frac{A}{2}\right)\tan\frac{A}{2},$$

$$\tan^{-1}\frac{x\cos\phi}{1 - x\sin\phi} - \tan^{-1}\frac{x - \sin\phi}{\cos\phi} = \phi.$$

9. Two sides and the included angle of a triangle being given find the remaining angles.

If one of the given sides be half the other, and the included angle be 60°, find the other angles.

10. Find in terms of the sides of the triangle (1) the radius of the inscribed circle, (2) the radius of the circle touching one side and the other two sides produced.

If ABC be the triangle and the circles touch the side BC in D and E respectively, shew that $BD = CE$.

11. State De Moivre's theorem, and apply it to shew that if

$$\frac{a}{\sqrt{(a^2 + b^2)}} = \cos\theta,$$

then $\sqrt[3]{\{a + b\sqrt{(-1)}\}} + \sqrt[3]{\{a - b\sqrt{(-1)}\}} = 2\sqrt[6]{(a^2 + b^2)}\,.\cos\frac{1}{3}\theta.$

12. Prove the theorem

$$2\cos n\theta = (2\cos\theta)^n - n(2\cos\theta)^{n-2} + \frac{n.(n-3)}{1.2}(2\cos\theta)^{n-4} - \&c.$$

Find the general term, and the last terms of the series, (1) when n is even, (2) when n is odd. State further whether the theorem holds for any value of n, and give your reason.

GEOMETRICAL CONIC SECTIONS.

13. In the parabola the perpendicular from the focus on the tangent at any point intersects it in the tangent at the vertex. Shew that the circle described upon any radius vector touches the tangent at the vertex.

14. Shew that the area of all parallelograms circumscribing an ellipse, whose sides are parallel to conjugate diameters, is constant, and is less than that of any other circumscribing parallelogram.

15. In the hyperbola the area of the triangle contained by the asymptotes and the tangent at any point of the curve is constant.

16. The section of a cone made by a plane parallel to a straight line in the surface of the cone is a parabola.

Determine that parabolic section of a given cone, which shall have its latus-rectum of a given magnitude.

VI.—ALGEBRA.

1. Two men invest £300 and £100 in a machine; it works half-a-year for each of them; determine what one must pay the other if they would have made 30 per cent. on the money by letting the machine.

2. Explain the use of brackets, and shew that $a - (b - c)$ is equal to $a - b + c$.

Simplify $\quad a\{a + x(a - x)\} - x\{x - a(x - a)\}$

$$(x^2 + xy + y^2)^2 - (x^2 - xy + y^2)^2.$$

3. Divide

$$a^5 + a^4b + a^3b(b + x) + a^2b^2x(1 + bx) + ab^3x(1 + bx) + b^5x^2,$$

by $a^2 + ab + b^2$,

and $\quad x^{\frac{3}{4}} + 3x^{\frac{1}{4}} + \dfrac{3}{x^{\frac{1}{4}}} + \dfrac{1}{x^{\frac{3}{4}}}$ by $x^{\frac{1}{2}} + 2 + \dfrac{1}{x^{\frac{1}{2}}}$.

Divide 1 by $1 - x$ to four terms, and shew that

$$\frac{x + 1}{x} = 1 + \frac{1}{1 + x} + \frac{1}{(1 + x)^2} + \ldots.$$

4. Define the Least Common Multiple. Shew how to find it for two or more Algebraical Expressions. Shew that the method followed in Arithmetic gives the Least Common Multiple.

5. Shew that a quadratic equation cannot have more than two roots.

Determine under what circumstances a quadratic will have only one root.

Solve the following equations:

$$\frac{1}{1 - x} + \frac{1}{1 + x} + \frac{1}{1 + 2x} = \frac{3}{(1 - x)(1 + x)(1 + 2x)},$$

$$(x^{\frac{1}{3}} - 1)^2 + 4x^{\frac{1}{2}} - 5 = 0, \quad \sqrt{(2x^2 + 1)} + \sqrt{(2x^2 + 3)} = 2\,(1 - x),$$

$$\frac{1}{\sqrt{(x + y)}} + \frac{1}{\sqrt{(x - y)}} = \frac{3}{4}, \quad \sqrt{(x + y)} + \sqrt{(x - y)} = 6.$$

6. Shew how to find the sum of any arithmetical progression.

Prove by induction that

$$1^3 + 2^3 + 3^3 + \ldots\ldots \qquad + n^3 = (1 + 2 + \ldots\ldots + n)^2.$$

7. Assuming the Binomial Theorem for an integral index, prove it when the index is a fraction.

Write down the general term in the expression of $(1 - 2x)^{-\frac{1}{2}}$.

8. Shew that $a^x = 1 + Ax + \dfrac{A^2x^2}{1.2} + \ldots.$

Solve the equation $10^x = 101$ to five places of decimals, having given $\log_e 10 = 2.30258$.

9. If £100 be distributed in charity in sums of £20, £1, and 1*s*. among 100 recipients, determine how many received the first, second, and third sums.

ANALYTICAL GEOMETRY.

10. Determine the equation to a straight line in terms of its inclination to the axis of x and the portion intersected between the origin and the axis of y.

Draw the lines represented by

$$y = \frac{x}{\sqrt{3}} + c, \quad y = -\frac{x}{\sqrt{3}} + c, \quad \text{and } y = d,$$

and find the area included between them.

11. Shew that the equation to a straight line may be written in the form $x \cos\alpha + y \sin\alpha = p$, when p is the perpendicular from the origin on the line and α the inclination of the perpendicular to the axis x.

Find the length of the perpendicular from any other point upon the line.

12. Find the angle between the lines whose equations are given, and determine the condition that the lines may be at right angles to one another.

13. Find the equation to a circle when the origin is at the extremity of a diameter along which one of the axes is taken.

Find it also in terms of polar co-ordinates.

14. Define a parabola and find its equation.

Trace the curve $y^2 = 2c\,(x - c)$.

If from the origin tangents be drawn to this curve, shew that the points of contact for different values of c will be on the straight lines $y^2 - \frac{1}{2} x^2 = 0$.

15. Find the equation to the tangent of an ellipse.

Shew that if two ellipses be described on the same minor axis, tangents drawn at the extremities of a common ordinate to the minor axis will intersect this axis in the same point.

16. Shew that in an ellipse the normal bisects the angle between the focal distances.

If P be a point on an ellipse, Q and Q' the points where the normal at P meet the major and minor axes respectively, shew that the loci of the middle points of PQ and PQ' will be ellipses, and that the locus of the middle point of QQ' will be a circle.

SCHOLARSHIP EXAMINATION.

GONVILLE AND CAIUS COLLEGE. *April*, 1862.

I.

Translate with short explanatory and illustrative notes:

From Τὸν δ' αὖτ' Ἰδομενεὺς Κρητῶν ἀγὸς....
to ....κιὼν ἔλευ ὄβριμον ἔγχος.
HOM. *Iliad*, XIII. 274—294.

From Οὐ τοίνυν οὐδ' ἃ πέπλασται....
to ....ποιήσετε καὶ οὐχὶ δίκαια.
DEMOSTH. κατὰ Στεφάνου A.

From Οὐδέποτε δίδυμα λέκτρ' ἐπαινέσω....
to ....μετατροπὰ τῶνδ' ἔπεισιν ἔργων.
EURIP. *Andromache*, 464—491

From Ὅτι μὲν τοίνυν ἀθάνατον ψυχή,....
to ....εἴτε ὅπῃ ἔχει καὶ ὅπως.
PLATO, *Repub.* X. 611, 612.

II.

For Greek Iambics:

What is this life to me? not worth a thought;
Or, if it be esteemed, 'tis that I love it
To win a better: even thy malice serves
To me but as a ladder to mount up

To such a height of happiness, where I shall
Look down with scorn on thee, and on the world;
When circled with true pleasures, placed above
The reach of death or time, 'twill be my glory
To think at what an easy price I bought it.
There's a perpetual spring, perpetual youth;
No joint-benumbing cold, or scorching heat,
Famine, nor age, have any being there.

MASSINGER.

For Greek Prose:

But such is the nature of man that prosperity itself produces disquiet. Peace, internal and external, is not always within the power of the wisest prince; the choice of evils only is left to him; and, though despotic chief of a state the most dreaded by neighbouring nations, he may be under a necessity to make war. Thus it seems to have been with Darius. The Persians had been accustomed to respect, in their sovereigns, first their right of inheritance, then their character as conquerors. Ambitious spirits, long used to military activity, could ill bear rest: and the gains of conquest would not soon be forgotten by the greedy. All circumstances therefore considered, it may have been much more a matter of necessity than of choice for Darius to seek for a war to wage. Of all the nations surrounding the Persian empire, the wild people of the frozen regions of Scythia could alone be deemed formidable to it. Darius resolved to lead an army against them by the western side of the Euxine sea.

MITFORD.

III.

Translate with explanatory notes:

From BA. Quid agitur, Calidore? CA. Amatur....
to CA. ....lex me perdit quina vicennaria?

PLAUT. *Pseudol.* I. III. 54—84.

Supply the *lacuna* in the following line v. 77.

Ps. Heus tu, postquam hercle isti a mensa surgunt* * *

From Vernaculorum dicta, sordidum dentem,....
to ....constare gratis quum silentium possit?

MART. *Epigr..* X. 3

From Romani consules priusquam educerent....
to ....in totam penitus aciem pervasit.
LIVY VIII. 9.

From Redii Romam Fonteii causa a. d. VII idus Quint.....
to ....Cato potuerit, quam omnes quidem judices.
CICERO *ad Att.* IV. 15.

Line 5. *nihil tam verum.* Discuss this reading.

IV.

For Latin Hexameters:

But when afar
The sudden bugle on the rosy cliff
Was splintered into echoes, from the marsh
The heron screaming rose; within his wood
The mountain bull stood listening to the sound,
Silent as lowering thunder, when the winds
Are choked, and leaves hang dead: and from his lair
Rose with dew-dappled flanks the stag and snuffed
Their coming in the wind, a moment stood,
His speed in all his limbs: but when the pack
Dragged with them down the echoes of the vale
With antlers laid he fled. Halloo and horn
Broke then upon the breeze. Now on his flight
By flying wood, o'er wastes, thro' streams that splashed
High o'er the saddle girths, the hunters hung,
And ever as a slowly burning fire
Consumed the space between.

Edwin of Deira.

For Latin Prose:

About noon, Henry after having encouraged his troops, cried aloud, "Advance banners!" The order ran along the short line, and was answered with shouts of enthusiasm. The French cavalry advanced to the charge through multiplied difficulties. The slippery state of the ground, and the shower of arrows poured on them by the English bowmen, galled and exasperated the horses beyond the power of guidance; and they were thus driven back on their main body in confusion and disorder. That proud and gallant army, having rejected all plebeian aid, had no arms to oppose to the strong arrows of the sturdy yeomen of England.—

Scarcely able to stand upon the marshy ground, they were cooped up by their unskilful leaders, in a space so narrow that they could not move. Valour became of no avail. It seemed as if the French were to be victims, crowded into a theatre, to be unresistingly slaughtered. In their attempt to escape, not so much from the fury of their adversaries, as from the incapacity of their leaders, they are said to have sustained a loss of not less than thirty thousand men; a computation which seems to be moderate, if we comprehend in it the prisoners, whose fate we have now to record.

MACKINTOSH.

V.—EUCLID AND GEOMETRICAL CONIC SECTIONS.

1. Define a *right line*, a *right angle*, *parallel lines*, a *rhombus*, and an *acute-angled triangle*.

2. The angles at the base of an isosceles triangle are equal to one another; and, if the equal sides be produced, the angles on the other side of the base shall also be equal.

Prove, without assuming any proposition subsequent to the preceding, that the diagonals bisect the angles of a rhombus.

3. All the exterior angles of any rectilineal figure are together equal to four right angles.

Consider the case of a rectangle, from which a rectangular piece, at one of the angles, is taken away.

4. In a right-angled triangle, the square on the side subtending the right angle is equal to the sum of the squares on the sides containing the right angle.

ABC is an equilateral triangle; from D, the middle point of BC, DE is drawn perpendicular to AB: shew that BE is one-fourth of AB.

5. If a straight line be divided into any two parts, the squares on the whole line and one of the parts, shall be together equal to twice the rectangle contained by the whole line and that part, together with the square on the other part.

Deduce the same from the preceding propositions of the Second Book.

6. The opposite angles of a quadrilateral inscribed in a circle, are together equal to two right angles.

Shew that no parallelogram, except a rectangle, can be inscribed in a circle.

7. If a straight line AD be drawn touching a circle, and another straight line ABC be drawn cutting the circle in B and C, shew that the square on AD is equal to the rectangle contained by AB, AC.

If the diameter DE be drawn, and AE be joined cutting the circle in F, shew that the rectangle contained by AE, EF is independent of the position of A.

8. Inscribe a circle in a given triangle.

9. If a straight line be drawn parallel to the base of a triangle, it will cut the other sides, or these produced, proportionally.

10. Define a parabola; and find the locus of the centre of a circle which touches a given straight line, and passes through a given point.

11. In an ellipse, prove that, with the usual notation, $SY.HZ = BC^2$. Prove also that $CD.SY = BC.SP$.

12. Prove that, in an ellipse, the rectangle under the abscissæ of any diameter is to the square on the semi-ordinate, as the square on the diameter is to the square on the conjugate.

On PN, any ordinate of an ellipse, produced if necessary, is taken a point Q, such that NQ is to NP as the diameter conjugate to PN is to the diameter parallel to PN; prove that the locus of Q is an ellipse, and determine the positions of its axes.

13. Prove that the difference of the squares on any two conjugate diameters of an hyperbola is constant. In what case are the two conjugate diameters equal?

14. If a right cone be cut by a plane parallel to any tangent plane, prove that the section is a parabola.

VI.—ARITHMETIC, ALGEBRA, AND TRIGONOMETRY.

1. Reduce £693. 15*s*. to the decimal of £750, and express ·485 of a year in days, hours, minutes, and seconds.

2. Find the Highest Common Divisor of

$$(x + y)^7 - x^7 - y^7 \text{ and } (x^3 - y^3)^2.$$

3. Solve the following equations:

$$(\alpha)\ (x^2 - 3x + 7)^{\frac{1}{2}} + (x^2 - 4x + 69)^{\frac{1}{2}} = 14. \quad (\beta)\ x^4 - 4x + 3 = 0.$$

$$(\gamma)\ x + y = 1, \quad x^5 + y^5 = 211.$$

$$(\delta)\ x + \frac{1}{y +}\,\frac{1}{x +}\,\frac{1}{y +} \ldots = a, \quad y + \frac{1}{x +}\,\frac{1}{y +}\,\frac{1}{x +} \ldots = b.$$

4. Find the common ratio of a geometric series, in which the difference between any two consecutive terms is half of their sum.

If also the sum of the first and third terms be equal to the difference of the squares of the first and second terms, determine the series.

5. Assuming the Binomial Theorem for a positive integral value of the index, prove it when the index is a positive fraction.

Prove that $(n^2-2)^{\frac{1}{2}} = \frac{n^2-1}{n}\left\{1 - \frac{1}{2}\frac{1}{(n^2-1)^2} - \frac{1}{8}\frac{1}{(n^2-1)^4}\right.$

$$\left. - \frac{1}{16}\frac{1}{(n^2-1)^6} - \frac{5}{128}\frac{1}{(n^2-1)^8}\dots\right\}.$$

Apply this formula to investigate the square root of 223, to five places of decimals.

6. Define Permutations and Combinations; and find the number of permutations which can be made of n things taken all together, of which α are of one sort, β of another......

In how many ways may the letters of the word *restlessness* be arranged?

7. Define a logarithm; and prove that, if $a, b, c\dots$ be in geometrical progression, $\log_a N$, $\log_b N$, $\log_c N\dots$ will be in harmonical progression.

8. Define the *sine*, *tangent*, and *secant* of an angle: and trace the changes in the sign and magnitude of $\sec\theta$ as θ increases from 0° to 360°.

Trace also the changes in the sign of $\sec\theta - 3 + 2\cos\theta$ as θ increases from 0° to 360°.

9. Prove geometrically that

(1) $\sin(A+B) = \sin A\cos B + \cos A\sin B$.

(2) $\sin(A+B) + \sin(A-B) = 2\sin A\cos B$.

10. Prove the formulæ,

(1) $$\sin^2 A(1 + n\cot^2 A) + \cos^2 A(1 + n\tan^2 A) = \sin^2 A(n + \cot^2 A) + \cos^2 A(n + \tan^2 A).$$

(2) $$\cos 2(\alpha+\beta+\gamma)\sin 3(\alpha+\beta) + \cos(\gamma-\alpha)\sin(\gamma-\beta) = \sin 2(\alpha+\beta+\gamma)\cos 3(\alpha+\beta) - \sin(\gamma-\alpha)\cos(\gamma-\beta).$$

If $\tan^{-1}(x+1)\sqrt{(2)} - \tan^{-1}\frac{x-1}{\sqrt{2}} = \cot^{-1}\{4\sqrt{(2)}\}$, find x.

11. If a, b, c denote the sides of the triangle ABC which respectively subtend the angles A, B, C, prove that

$$\cos A = \frac{b^2+c^2-a^2}{2bc}.$$

If a^2, b^2, c^2 be in Arithmetical Progression, shew that

$$\frac{\sin 3B}{\sin B} = \left(\frac{a^2-c^2}{2ac}\right)^2.$$

12. Given two sides of a triangle and the included angle, determine the triangle completely.

If the ratio of the two sides be $1 : \sqrt{3} - 1$ and the included angle be 60°, find the other angles.

13. Find the radius of the circle which touches one side of a triangle and the other two produced.

If r_1, r_2, r_3 be the radii of the three escribed circles which touch the sides a, b, c respectively, shew that r_1, r_2, r_3 will be in Harmonical Progression, when a, b, c are in Arithmetical Progression.

VII.—ALGEBRA, TRIGONOMETRY, AND ANALYTICAL GEOMETRY.

1. Investigate the expansion of a^x in a series proceeding by ascending powers of x; and prove that, if ε be a quantity, such that $\varepsilon^x = 1 + x + \frac{x^2}{1.2} + \ldots$ then the coefficient of x, in the expansion of a^x, will be equal to $\log_\varepsilon a$.

Prove that $\frac{1}{\varepsilon} = \frac{1}{1.3} + \frac{1}{1.2.3.5} + \frac{1}{1.2.3.4.5.7} + \ldots$; and thence shew that its value, to five places of decimals, is ·36788.

2. Assuming Fermat's theorem, prove that, if p be a prime number, $1.2.3\ldots(p-2) - 1$ is divisible by p.

3. Prove that the successive convergents to any fraction are in their lowest terms; and investigate the formula connecting any numerator with the corresponding quotient and the preceding two numerators.

4. If $$2\cos\theta = x + \frac{1}{x}, \text{ and } 2\cos\phi = y + \frac{1}{y},$$
prove that $2\cos(\theta + \phi) = xy + \frac{1}{xy}$, and $2\cos(\theta - \phi) = \frac{x}{y} + \frac{y}{x}$.

Prove that $$2^n \cos\theta \cos 2\theta \cos 2^2\theta \ldots \cos 2^n\theta$$
$$= \cos\theta + \cos 3\theta + \cos 5\theta + \ldots + \cos(2^{n+1} - 1)\,\theta.$$

5. Discuss the ambiguous case in the solution of triangles.

With which of the following sets of data is the triangle ambiguous? Two angles and the area—two sides and the area—a side, the opposite angle, and the perimeter.

6. What are represented by the following equations?

(1) $x = a,\ y = b$. (2) $r = c,\ \theta = \alpha$. (3) $x = a,\ r = c$.

(4) $y = b,\ \theta = \alpha$. (5) $x = a$. (6) $r = c$. (7) $\theta = \alpha$.

7. A straight line is drawn through a point (hk) in a direction making an angle α with the axis of x; find the length of that part of it, which is intercepted between (h, k) and the line $Ax + By + C = 0$, supposing the axes of co-ordinates to be at right angles to one another.

Hence deduce the length of the perpendicular drawn from (hk) to the line $Ax + By + C = 0$.

8. Find the equation of a straight line joining two given points.

Apply this equation to prove that the straight lines, joining the angular points of a triangle with the middle points of the opposite sides, meet in a point.

9. Investigate the equation of the circle under the form

$$(x - a)^2 + (y - b)^2 = c^2.$$

Find the equation of the circle which passes through the origin and through a given point on each axis; also that of the circle which touches the co-ordinate axes.

10. Define a parabola; and find its equation.

Trace the curves

$$(1)\ (x - a)^2 = b(2b - y), \qquad (2)\ y^2 = a(x + y).$$

11. Find the equation of the tangent at any point of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$. If ϕ be the eccentric angle corresponding to the point, shew that the equation becomes

$$\frac{x \cos\phi}{a} + \frac{y \sin\phi}{b} = 1.$$

Hence shew that, if P and D be points in the auxiliary circle corresponding to the extremities of two conjugate diameters in an ellipse of which the center is C, the angle PCD is a right angle.

12. Find the equation of an hyperbola referred to its asymptotes as axes.

A straight line is drawn perpendicular to the transverse axis at a distance c from the origin; find the equation of the two straight lines joining the origin with the points where the first straight line meets the curve. If the two straight lines be at right angles, shew that

$$c = \frac{ab}{(b^2 - a^2)^{\frac{1}{2}}},$$

where a, b are the semi-axes of the hyperbola.

VIII.—PROBLEMS.

1. AD is drawn perpendicular to AB the hypothenuse of a right-angled triangle ABC, equal to AC; shew that CD is parallel or perpendicular to the line bisecting the angle ABC.

2. A, B, C, D, are four points in the circumference of a circle, the arcs AB, BC, CD, DA, are bisected in E, F, G, H, respectively; prove that EG is perpendicular to FH.

3. Prove that $(a^2+b^2+c^2)^3+2(bc+ca+ab)^3$

$$-3(a^2+b^2+c^2)(bc+ca+ab)^2=(a^3+b^3+c^3-3abc)^2.$$

4. If $\qquad (pq-r)^2+4(p^2-q)(pr-q^2)=0,$

prove that $\qquad 4(p^2-q)^3=(2p^3-3pq+r)^2,$

and that $\qquad 4(q^2-pr)^3=(2q^3-3pqr+r^2)^2.$

5. Solve the equations:

$$y^{\log z}z^{\log y}=a^2,\quad z^{\log x}x^{\log z}=b^2,\quad x^{\log y}y^{\log x}=c^2.$$

6. Straight lines AO, BO, CO are drawn bisecting the sides BC, CA, AB of a triangle ABC in the points D, E, F, respectively; r_1, r_2, r_3 are the radii of the circles circumscribed about the triangles EOF, FOD, DOE; shew that

$$\frac{OA^2.r_1^2}{a^2}=\frac{OB^2.r_2^2}{b^2}=\frac{OC^2.r_3^2}{c^2}=\frac{1}{3}\,\frac{a^2+b^2+c^2}{\dfrac{a^2}{r_1^2}+\dfrac{b^2}{r_2^2}+\dfrac{c^2}{r_3^2}}.$$

7. If $\tan A\sec A+\tan B\sec B+\tan C\sec C+2\tan A\tan B\tan C=0$, prove that $\sec^2A+\sec^2B+\sec^2C=1\pm2\sec A\sec B\sec C$.

8. The straight line which bisects the angle PTQ between two tangents to a parabola of which the focus is S, meets the axis of the parabola in R; prove that $ST=SR$.

9. Two parallel chords, subtending a right angle at the focus S of a parabola, and a line parallel to them drawn through the foot of the directrix, meet the latus rectum in P, Q, and R, respectively; prove that the difference of SP and SQ is $2SR$.

10. If P, Q be two points on an ellipse such that the sum of their abscissæ is constant, the locus of the intersection of the tangents at P and Q is a similar and similarly situated ellipse, passing through the center of the former.

11. SP_1, SP_2, $SP_3 \ldots SP_n$ are radii vectores drawn from the focus S of a conic, the angles P_1SP_2, $P_2SP_3 \ldots P_nSP_1$ being equal to one another; shew that

$$\frac{1}{SP_1}+\frac{1}{SP_2}+\ldots+\frac{1}{SP_n}=\frac{n}{SL},$$

and that, when n is greater than 2,

$$\frac{1}{SP_1^2} + \frac{1}{SP_2^2} + \ldots + \frac{1}{SP_n^2} = \frac{n}{SL}\left(1 + \frac{e^2}{2}\right).$$

$2SL$ being the latus-rectum and e the eccentricity of the conic.

12. If $x^2 + y^2 = a^2$, $(x - b)^2 + y^2 = c^2$, be the equations of two circles, such that a triangle, whose sides are tangents to the former, can be inscribed in the latter, prove that $2ac + b^2 - c^2 = 0$.

13. If α, β be the eccentric angles of the extremities of any focal chord of an ellipse, prove that the length of the chord is $2a \sin^2 \frac{1}{2}(\alpha - \beta)$; $2a$ being the axis-major of the ellipse.

14. If S, H be the foci of an hyperbola, and P any point of the curve, on the branch nearer to S, prove that the tangent of one-fourth of the angle between the asymptotes is a mean proportional between $\tan \frac{1}{2} SHP$ and $\cot \frac{1}{2} HSP$.

CORPUS CHRISTI COLLEGE.

SIR NICHOLAS BACON'S SCHOLARSHIP. *October*, 1862.

I.

TRANSLATE, adding a brief note where a word or a construction seems to require it:

1. *From* Εἶς γε μὴν δικαιοσύνην....
to ....ὅτου ἕκαστον αἰσθάνοιτο ἐπιθυμοῦντα.
XENOPHON, *Anabasis*, I.

2. *From* Ἁπάντων τοίνυν,....
to ....ὀργιζόμενοι φαίνεσθε.
DEMOSTH. *in Meid.*

3. *From* Τούτων δὲ τῶν....
to ....καλέουσι Πέρσαι ἀγγαρήϊον.
HEROD. VIII.

4. *From* Ἀλλὰ μὴν νόσων....
to ....καὶ ἔργα τἀληθὲς νοῆσαι.
PLATO, *Phædrus*, § 48, p. 244.

II.

Translate, with short notes explanatory or illustrative:

1. *From* ἀλλ' ἄγε, μοὶ τόδε εἰπὲ,....
to ....παῖδες σχεδὸν εἵαται, οὐδὲ γυναῖκες.
HOMER, *Il.* x., 405—422.

2. *From* ΚΛ. ἀνωλόλυξα μὲν πάλαι....
to ....ὡς γυναικὶ γενναίᾳ λακεῖν.
ÆSCHYLUS, *Agam.* 570—597.

3. *From* Δειλινὸν ὡς κατέδαρθον....
to ....καὶ οὐ φεύγοντος ἔτεινα.
THEOC. *Idyll*, XXI, 31—51.

4. *From* Εἴην ὅϑι δαΐων
....
to Ῥεας φίλον υἱόν.

III.

For Greek Iambics:

He look'd, and saw wide territory spread
Before him; towns and rural works between,
Cities of men, with lofty gates and tow'rs,
Concourse in arms, fierce faces threat'ning war,
Giants of mighty bone, and bold emprise:
Part wield their arms, part curb the foaming steed,
Single or in array of battle ranged
Both horse and foot; nor idly must'ring stood.
One way a band select, from forage drives
A herd of beeves, fair oxen and fair kine,
From a fat meadow-ground; or fleecy flock,
Ewes and their bleating lambs over the plain,
Their booty. Scarce with life the shepherds fly,
But call in aid; which makes a bloody fray.
With cruel tournament the squadrons join:
Where cattle pastured late, now scatter'd lies
With carcases and arms th' insanguined field
Deserted.

For Greek Prose:

Solon. Tyrants will never be persuaded that their alarms and sorrows, their perplexity and melancholy, are the product of tyranny: they will not attribute a tittle of them to their own obstinacy and perverseness, but look for it all in another's. They would move everything and be moved by nothing; and yet lighter things move them than any other particle of mankind.

Pisistratus. You are talking, Solon, of mere fools.

Solon. The worst of fools, Pisistratus, are those who once had wisdom. Not to possess what is good is a misfortume; to throw it away is a folly: but to change what we know hath served us, and would serve us still, for what never has and never can, for what on the contrary hath always been pernicious to the holder, is the action of an incorrigible idiot. Observations on arbitrary power can never be made usefully to its possessors. There is not a foot-page about them at the bath whose converse on this subject is not more reasonable than mine would be. I could adduce no argument which he would not controvert, by the magical words "practical things" and "present times:" a shrug of the shoulder would overset all that my meditations have taught me in half a century of laborious inquiry and intense thought. "These are theories," he would tell his master "fit for Attica before the olive was sown among us. Old men must always have their way. Will their own grey beards never teach them that time changes things?"

IV.

Translate with brief notes:

1. *From* Postero die ingentes tumultus ciere....
   to ....plebis negavit se Gracchum morari.
   LIVIUS XLIII. 16.
2. *From* Quodsi in iis rebus repetendis....
   to ....communem salutem defendendam vocare.
   CICERO, *pro Murena, II.*
3. *From* Trans Saionas aliud mare pigrum....
   to ....mox ut in picem resinamve lentescit.
   TACITUS, *Germ. c.* 45.
4. *From* Non in alia re tamen damnosior....
   to ...nonnisi ad opus damnari præceperat.
   SUETONIUS, *Nero, c.* 31.

V.

Translate with brief notes:

1. *From* Intactis opulentior....
   to ....Æquali recreat sorte vicarius.
2. *From* Ollud in heis rebus longe....
   to ... et noctes parilis agitare diebus.
3. *From* Luce minus decima dominam....
   to ....a magnis hunc colit ille deis.
4. *From* Sæpe ego, quum flavis messorem....
   to ....Cyllenius erret in orbes.
5. *From* Dic igitur, quid causidicis....
   to ....partes ex fœdere pragmaticorum.

VI.

For Latin Elegiacs:

River! that in silence windest
  Through the meadows, bright and free,
Till at length thy rest thou findest
  In the bosom of the sea!

Four long years of mingled feeling,
  Half in rest and half in strife,
I have seen thy water stealing
  Onward, like the stream of life.

Thou hast taught me, silent river!
  Many a lesson, deep and long;
Thou hast been a generous giver,
  I can give thee but a song.

Oft in sadness, and in illness,
  I have watched thy current glide,
Till the beauty of its stillness
  Overflowed me, like a tide.

For Latin Prose:

Our soldiers, under the command of Scipio, have subdued two countries, of a soil more fertile than ours, and become by a series of battles, and by intestine discord, less populous: let them divide and enjoy it. The beaten should always pay the expenses of the war, and the instigators should be deprived of their possessions and their lives. Which, I pray you, is the more reasonable; that the Roman people shall incur debts by having conquered, or that the weight of those debts shall fall totally on the vanquished? Either the war was unjust against *them*, or the conditions of peace against *us*. Our citizens are fined and imprisoned (since their debts begin with fine and end with imprisonment) for having hurt them. What! shall we strike and run away? or shall our soldier, when he hath stripped the armour from his adversary, say, 'No, I will not take this: I will go to Rome, and suit myself with better!'

EXAMINATION FOR EXHIBITIONS.

King's College. *June*, 1866.

I.

PART. I.

[*N.B. Candidates who are sufficiently advanced may pass on to the second part of the paper, omitting the elementary questions, with the exception of those marked thus*.*]

1. On the same base, and on the same side of it, there cannot be two triangles which have their sides, which are terminated in one extremity of the base equal to one another, and likewise those which are terminated in the other extremity.

2. Any two sides of a triangle are together greater than the third side.

*3. All the exterior angles of any rectilineal figure are together equal to four right-angles.

4. Describe a parallelogram equal to a given rectilineal figure, and having an angle equal to a given rectilineal angle.

5. If a straight line be divided into any two parts, the rectangles contained by the whole and each of the parts are together equal to the square on the whole line.

*6. Describe a square equal to a given rectilineal figure.

7. One circumference of a circle cannot cut another in more than two points.

8. Draw a straight line from a given point either without or in the circumference of a circle which shall touch the circle.

*9. State and prove Euclid's proposition relating to the properties of a quadrilateral figure described in a circle.

PART II.

1. Describe a circle about a given triangle.

2. Describe an isosceles triangle, having each of the angles at the base double of the third angle.

3. The sides about the equal angles of triangles, which are equiangular to one another are proportionals.

4. Find a third proportional to two given lines.

5. Similar triangles are in the duplicate ratio of their homologous sides.

6. The rectangle contained by the diagonals of a quadrilateral figure inscribed in a circle is equal to both the rectangles contained by its opposite sides.

7. If two straight lines be parallel, and one of them be at right angles to a plane, the other also shall be at right angles to the same plane.

8. Planes, to which the same straight line is perpendicular, are parallel to one another.

9. Every solid angle is contained by plane angles, which are together less than four right-angles.

10. Define the focus and directrix of a conic section, and shew that if PQ a chord of a conic section meet the directrix in R, and PS, QS be joined to the focus, SR bisects either the angle PSQ or the supplement of it. Draw a figure representing each case.

11. Prove in the parabola that $SY^2 = SP \,.\, SA$,
$SP = ST = SG$, (G being the foot of the normal) $QV^2 = 4SP \,.\, PV$.

12. Give a geometrical construction for drawing two tangents from an external point to an ellipse.

13. Prove in an ellipse that
$$SY \,.\, HZ = BC^2,\ PF \,.\, CD = AC \,.\, BC,\ SP \,.\, HP = CD^2.$$

14. Define the asymptotes of a hyperbola, and shew that the parts intercepted between the curve and asymptote of a straight line meeting both are equal.

15. Prove that $CP^2 - CD^2 = AC^2 - BC^2$.

16. Shew that a plane section of a cone meeting one sheet only is an ellipse.

II.

PART I.

(N.B. *Candidates who are sufficiently advanced may pass on to the second part of the paper, omitting the elementary questions, with the exception of those marked thus* *).

1. Define the terms *integer*, *fraction*, *mixed number*, and shew that a simple fraction may be considered as representing the quotient arising from the division of the numerator by the denominator.

2. Extract the square root of 965460423716 and the cube root of 700227072, and prove that $2\frac{9}{14}$ differs from the square root of 7 by a quantity less than $\frac{3}{1000}$.

3. A rectangular field contains 8 acres, and the length of one of its sides is a furlong. Find its perimeter.

4. Reduce 5 cwt. 7 lbs. 14 oz. to the decimal of a ton, and find the value of $\cdot\dot{2}8571\dot{4}$ of a guinea.

5*. The wages of one man, one woman, and three children amount to 30 shillings per week. The man and one child earn together 4 times as much as the woman. The man and the three children earn 5 times as much as the woman. Find the wages of each.

6. Simplify the following expressions:

$$(x-a)(x^3+ax^2+a^2x+a^3)-(x^2-a^2)(x+a)^2;$$

$$\frac{a^3-b^3}{a-b}-\{3a^2-(2a-b)a\};\ \left(\frac{a^2+b^2-c^2}{ab}-2\right)\left(\frac{a^2b+ab^2-abc}{a+b+c}\right).$$

7. Find the least common multiple of

$$a-x,\ a^4-x^4,\ ab-ax-bx+x^2.$$

8*. Prove that when m and n are positive integers, $a^m \times a^n = a^{m+n}$.

How do you proceed to give a meaning to a^n, when n is fractional or negative?

9. Solve the equations:

$$\frac{4x}{5-x}-\frac{20-4x}{x}=\frac{15}{x},\quad 5x-\frac{2x+1}{3}+6=3x+\frac{x+3}{2}+10,$$

$$\sqrt{(x)}+\sqrt{\{a-\sqrt{(ax+x^2)}\}}=\sqrt{(a)}.$$

10. *A* and *B* are connected by two lines of railway. The distance by the first exceeds that by the other, by 30 miles. A train proceeding by the longer route loses in stoppages one-tenth of the time occupied by the journey. Another train proceeding by the shorter route at a rate which is to that of the first as 21 : 20, loses in stoppages one-fifth of the time occupied by the journey. Both trains accomplish the distance in the same time. Find the distances by the two routes.

PART II.

1. Simplify the expression: $\dfrac{\sqrt{(a^2+x^2)}+\sqrt{(a^2-x^2)}}{\sqrt{(a^2+x^2)}-\sqrt{(a^2-x^2)}}-\left(\dfrac{a^4}{x^4}-1\right)^{\frac{1}{2}}$.

2. If $\dfrac{a}{b}=\dfrac{c}{d}$, prove that $\dfrac{ac+bd}{ad+bc}=\dfrac{a^2+b^2}{2ab}$,

and that $\sqrt[p]{\left(\dfrac{a+b}{c+d}\right)}=\sqrt[p]{\left(\dfrac{a-b}{c-d}\right)}$.

3. Shew that $x^4+2ax^3+b^2x^2+c^3x+d^4$ will be a perfect square, if

$$x=\frac{(a^2-b^2)^2-4d^4}{4a(a^2-b^2)+c^3}.$$

4. Solve the equations:

$$\text{(i)}\ \begin{cases} x^6 + y^6 = 65, \\ x^2 + y^2 = \ \ 5. \end{cases} \qquad \text{(ii)}\ \frac{\sqrt{x} + \sqrt{(x-a)}}{\sqrt{x} - \sqrt{(x-a)}} = \frac{\sqrt{p} + \sqrt{(p-a)}}{\sqrt{p} - \sqrt{(p-a)}}.$$

5. Assuming the Binomial Theorem for positive integral values of the index, prove it for a negative or fractional exponent.

6. Prove that the whole number of combinations of n things taken 1, 2, 3, ... n together is $2^n - 1$. Find also the sum of the series

$$1 + \frac{n(n-1)}{1.2} + \frac{n(n-1)(n-2)(n-3)}{1.2.3.4} + \text{\&c. } ad\ inf.$$

n being a positive fraction.

7. The number of balls in the ridge of a rectangular pile is $p + 1$, and the number in the smaller side of the base is n. Find the number of balls in the pile.

8. Prove that if C_1, C_2, C_3,... C_r &c. are the coefficients of the terms of any expanded binomial whose exponent is a positive integer,

$$C_1^2 + C_2^2 + C_3^2 + \ldots = \frac{2n.(2n-1)\ldots(n+2)}{1.2.3\ \ldots(n-1)}.$$

9. Prove the formula $\sin(A - B) = \sin A \cos B - \cos A \sin B$, and deduce from it the formulæ for

$$\cos(A + B),\ \cos(A - B) \text{ and } \tan(A - B).$$

10. Prove the formulæ: $3 \sin A - \sin 3A = 4 \sin^3 A$,

$$\cos 2A = \frac{1 - \tan^2 A}{1 + \tan^2 A}, \quad \cot^2(45^\circ + A) = \frac{1 - \sin 2A}{1 + \sin 2A}.$$

11. Find the radii of the inscribed and circumscribed circles of a triangle in terms of the sides.

12. If r, R, be the radii of the circles inscribed in, and described about, a given triangle, and r_1, r_2, r_3 be the radii of the circles described touching one side of the triangle and the two other sides produced, prove that

$$(r_1 - r)(r_2 - r)(r_3 - r) = 4Rr^2.$$

13. Prove that in any triangle

$$\tan\frac{A - B}{2} = \frac{a - b}{a + b} \cot\frac{C}{2}.$$

If in any triangle $a = 80$ yards, $b = 60$ yards, $C = 90^\circ$, find the other two angles.

Given

$\log 7 = {\cdot}8450980$, $L \tan 8^\circ 7' = 9{\cdot}1541739$, $L \tan 8^\circ 8' = 9{\cdot}1550769$.

14. Prove that $\cos\theta - \cos 2\theta + \cos 3\theta - \cos 4\theta + \&c. = \frac{1}{2}$.

15. Find the length of the perpendicular from the point x, y upon the straight line $x\cos a + y\sin a - p = 0$.

16. Find the polar equation of a conic section, the focus being the pole.

Two equal confocal ellipses have their axes inclined at an angle β, and a third confocal ellipse is described having the common chord of the two first ellipses for its major axis. Shew that the eccentricity of the new ellipse will be $e\cos\frac{\beta}{2}$, e being the eccentricity of the first ellipses.

17. In an ellipse if PCQ be a right angle, prove that

$$\frac{1}{CP^2} + \frac{1}{CQ^2} = \frac{1}{AC^2} + \frac{1}{BC^2}.$$

18. If $\alpha = 0$, $\beta = 0$, $\gamma = 0$ be the equations to the sides of a triangle ABC, shew that the equation to the straight line which joins the centres of the inscribed and circumscribed circles is

$$\alpha(\cos B - \cos C) + \beta(\cos C - \cos A) + \gamma(\cos A - \cos B) = 0.$$

III.

S. MATTHEW'S GOSPEL.

1. Translate:

(i) Chap. iv., v. 12.

Parse *διακαθαριεῖ, ἅλωνα, κατακαύσει.* Give the derivations of *ἀποθήκην, ἀσβέστῳ.*

(ii). Chap v., v. 3.

Compare this with the parallel passage in S. Luke. What expression in the above verse would not be found in classical Greek?

(iii). Chap. viii., v. 20.

On what occasion were the above words spoken? Derive *πετεινὰ, κατασκηνώσεις*

(iv). Chap. ix., v. 15-17.

Explain and derive *ἐπίβλημα, πλήρωμα, σχίσμα.*

(v). Chap. xxiii., v. 23-25.

Give the principal tenses of *ἀφήκατε, ποιῆσαι, καταπίνοντες.*

2. Explain *χρηματισθείς, ἐσκυλμένοι, ἄρτον τὸν ἐπιούσιον, κορβανᾶν, τῇ ἐπιφωσκούσῃ εἰς μίαν σαββάτων, δίδραχμα, σπυρίδας, κοφίνους.*

ODYSSEY. Book I.

Translate:

1. *From* v. 144. 'Ες δ' ἦλθον............
   to v. 162. ....κυλίνδει.

Parse ἑξείης, παρενήνεον, ἐπεστέψαντο, περικαλλέα, ὀνείαθ', πευθοίαθ', νεμεσήσεαι. Give the derivations of κλισμούς, κρητῆρας, ποτοῖο, ἑδετύος, μολπή, ἀναθήματα, νήποινον.

2. *From* v. 424. Δὴ τότε............
   to v. 444. ....'Αθήνη.

Parse δέδμητο, ἔμικτο, φιλέεσκε, ὤιξεν, πτύξασα, ἵμεν, ἐπέρυσσε, πέφραδ'. Derive ὑψηλός, περισκέπτῳ, ἐεικοσάβοια, πυκιμηδέος τρητοῖς, παννύχιος.

Translate:

From Ἔνθα σφέας ἐκίχαν'............
to ....βαλλομένοιο.

Homer, *Odyss.*, xvii., 212-232.

From Ὦ φίλτατ' Αἰγέως............
to ....ψεύσουσί με.

Soph., *Œd. Col.*, 607-628.

From Καὶ τότε, ὡς ἔοικεν, ἡμῖν ἔσται οὗ ἐπιθυμοῦμεν......
to ....οὕτως; παντός γε μᾶλλον, ὦ Σώκρατες.....

Plato.

---

(1). Give a brief account of the different views that have been held respecting the authorship of the Iliad and Odyssey.

(2). How often were plays exhibited at Athens? In what respects did the Greek drama differ from our own, and what were the causes of the differences?

(3.) Sketch the character of Socrates.

IV.

LIVY. BOOK XXI.

Translate:

1. *From* Legatos, ab sociis et pro sociis....
   to ....cum Romanis est.

Ch. x.

Explain the historical allusions.

2. *From* Ventum deinde....
to ....concretat glacie.
Ch. xxxvi.

Give the derivations of virgulta, luctatio, tabida, jumenta.

Give the principal tenses of retineo, moraretur, digressus, fallente, insistebant, adjuvissent, secabant, perfringebant.

3. *From* Ob cetera prodigia...
to ....animos.
Ch. lxii.

Write explanations where you think necessary.

Translate, with explanations:

From Et habuisset....
to ....petebant hostem.
Livy xxiv. 34.

From Libera currebant....
to ....mœsta virum.
Ovid. Fast. III. 111—134.

From Me vero primum....
to ....Sorores!
Virg. Georg. II. 475—494.

This last passage may be done into English verse.

V.

Translate:

I. Into Latin Prose:

Then Lucius plotted with the nobles, who hated the good king; and he joined himself to the sworn brotherhoods of the young nobles, in which they bound themselves to stand by each other in their deeds of violence and of oppression. When all was ready, he waited for the season of the harvest, when the commons, who loved the king, were in the fields getting in their corn. Then he went suddenly to the forum with a band of armed men, and seated himself on the king's throne before the doors of the senate-house, where he was wont to judge the people. And they ran to the king, and told him that Lucius was sitting on his throne. Upon this the old man went in haste to the forum, and when he saw Lucius, he asked him wherefore he had dared to sit on the king's seat. And Lucius answered, that it was his father's throne, and that he had more right in it than Servius. Then he seized the old man, and threw him down the steps of the senate-house to the ground; and he went into the senate-house, and called together the senators, as if he were already king. Servius meanwhile arose, and began to make his way home to his house; but when he was come near to the Esquiline Hill, some whom Lucius had sent after him overtook him and slew him, and left him in his blood in the middle of the way.

II. Into Greek Prose:

The most unprincipled of modern sovereigns would yet have acknowledged, that he owed a duty to his people, for the discharge of which he was answerable to God; but the Greek tyrant regarded his subjects as the mere instruments of his own gratification; fortune, or his own superiority, had given him extraordinary means of indulging his favourite passions, and it would be folly to forego the opportunity. It is this total want of regard for his fellow-creatures, the utter sacrifice of their present and future improvement, for the sake of objects purely personal, which constitutes the guilt of Dionysius and his fellow-tyrants. In such men all virtue was necessarily blighted; neither genius, nor courage, nor occasional signs of human feeling, could atone for the deliberate wickedness of their system of tyranny.

III. Into Latin Elegiacs:

Night clos'd around the conqueror's way,
And lightnings show'd the distant hill,
Where those who lost that dreadful day,
Stood few and faint, but fearless still.

The soldier's hope, the patriot's zeal,
For ever dimm'd, for ever crost—
Oh! who shall say what heroes feel,
When all but life and honour's lost?

The last sad hour of freedom's dream,
And valour's task, mov'd slowly by,
While mute they watch'd, till morning's beam
Should rise and give them light to die.

THE END.

CORRECTIONS AND ADDITIONS, 1867.

p. 11, after line 22, add:

The two Mawson Scholars who acquit themselves with most credit in the College Examination of the third year, receive an augmentation of £30 each.

p. 23, line 29, *for* £60 *read* £80.

After line 29, add:

The Rev. W. Whewell, D.D., late Master of the College, has by his will directed the endowment of two additional Scholarships of the same value, and subject to the same rules as the Foundation Scholarships of the College.

Line 34, *for* each of the value of £50 a year, *read*, two of £100 each, two of £75 each and two of £50 each.

p. 30. Add after line 33:

The Earl of Powis, High Steward of the University, has conveyed stock in the Public Funds to the University, producing yearly £5. 5*s*., to increase each of these Medals to the value of £5. 5*s*.

The Earl of Powis has also given a gold medal, as an annual prize for the best Exercise composed in Latin Hexameter Verse. Candidates must have resided not less than two terms, or at least be in their second year of residence. The prize exercise is to be recited in the Senate House, as the other prize exercises.

p. 35, after line 15, add:

The benefaction for the Barnes University Scholarship, accepted by grace of the Senate in 1844, has become available, and the election of the first Scholar will take place in the Lent Term, 1867. The candidates are required to be students in their first year, and a preference is reserved to candidates educated at Christ's Hospital, St. Paul's or Merchant Tailors' School, and who come to the University directly from one of these Schools.

The Scholarship is tenable for four years, and the stipend of it arises from the interest of £2000, 3 per cent. Consols.

p. 35, add after the Barnes Scholarship:

The Rev. W. Whewell, D.D., late Master of Trinity College, has left directions for the establishment of a Professorship of International Law in the University, with the following injunction:—"I enjoin the said Professor of International Law in his Lectures, and in all parts of his treatment of the subject of International Law, to make it his aim to lay down such rules and to suggest such measures as may tend to diminish the evils of war, and finally to extinguish war between Nations."

The Professorship question has been referred to a Syndicate which has not yet reported.

Dr. Whewell has also directed the establishment of Scholarships for Students of International Law, of such number, with such stipends, and subject to such rules and regulations, as the Master and Senior Fellows of Trinity College shall determine.

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